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THE AMERICAN GAS LIGHT JOURNAL

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[OFFICIAL NOTICE.]

Twenty-eighth Annual Meeting of the New England Association of Gas Engineers.

OFFICE OF THE SECRETARY, LYNN, MASS., Jan. 16, 1899.

To the Members of the New England Association of Gas Engineers:

The twenty-eighth annual meeting of the New England Association of Gas Engineers will be held at Young's Hotel, Boston, on *Thursday* and *Friday*, February 16th and 17th, 1899.

The matters for discussion will be announced later. Members are requested to send to the Secretary questions for the Question Box, and are especially urged to contribute to the meeting short papers on any subject pertaining to the business.

The Secretary will send blank applications for membership to those desiring them.

Carefully note the change of date from the usual Wednesday and Thursday to Thursday and Friday.

CHARLES F. PRICHARD, Secretary.

[OFFICIAL NOTICE.]

Sixth Annual Meeting, Michigan Gas Association.

OFFICE OF THE SECRETARY, SAGINAW, MICH., Jan. 11, 1899.

To the Members of the Michigan Gas Association: Gentlemen—The Sixth Annual Meeting of the Michigan Gas Association will be held in Lansing, on Wednesday, the 22d, and Thursday, the 23d, of February, next. Location of headquarters and list of papers to be presented will appear in due time. Respectfully, HENRY H. HYDE, Secy.

[OFFICIAL NOTICE.]

Change of Meeting Time, Western Gas Association.

WESTERN GAS ASSOCIATION, OFFICE OF THE SECRETARY, NEW ALBANY, IND., Jan. 10, 1899.

To the Members of the Western Gas Association:

On account of the inclement and disagreeable weather usually prevailing in Milwaukee during the month of May, the Board of Directors, acting upon the advice of the Entertainment and Executive Committees, have unanimously voted (with the exception of Mr. Littleton, who is in Europe), to change the date of the next annual meeting of the Western Gas Association, from May 17, 18 and 19, to June 14, 15 and 16.

Members of our Association, and all who may desire to attend our next annual meeting, will govern themselves accordingly.

JAMES W. DUNBAR, Secretary.

[OFFICIAL NOTICE.]

Wrinkle Department, Western Gas Association.

WESTERN GAS ASSOCIATION, OFFICE OF THE SECRETARY, NEW ALBANY, IND., Jan. 16, 1899.

To the Members of the Western Gas Association:

Mr. E. H. Jenkins, Editor of the Wrinkle Department, desires it known that those who have contributions to offer for publication in this valuable division of the Association's proceedings, should forward the same at as early a date as possible. All matter of this nature should be in hand not later than April 1st. Let no member fail to mail Mr. Jenkins a description of any device that saves labor or insures through its use better service in the production or distribution of gas.

Address all communications to Mr. E. H. Jenkins, Engineer Buffalo City Gas Company, Buffalo, N. Y. J. W. DUNBAR, Secretary.

BRIEFLY TOLD.

THE VERDICT OF THE CORONER'S JURY AS TO THE GASHOLDER COLLAPSE.—The hearing before Coroner Zucca and a jury, held to determine the cause of the death of Pious Baum (which verdict would relate to the demise of seven others), has been held and a verdict reached. As our readers are aware, a new 4-lift holder, located on the

storage division of the Consolidated Gas Company's plant at Avenue A and 21st street, New York, was in the preliminary stages of the air test (early the evening of December 13th last), when the tank in which it rested failed. The result was that eight persons lost their lives, several others sustained varying injuries, and much damage was done to surrounding and adjacent property. As the main facts in the case can be found in the JOURNAL for December 19, 1898, no further mention of such is necessary here. In view of the importance and magnitude of the happening, involving as it did a problem heretofore unencountered in the annals of gas works construction, Coroner Zucca went along slowly and safely in the preliminaries for the inquest. The latter was, after one or two postponements, brought off last week, the hearings having been commenced on Monday last and finished, by the rendering of a verdict, the succeeding day. The jury was exceptionally well qualified to consider a matter of the nature in hand, as the appended list will show: John Monks, ex-Dock Commissioner; C. Wilson Atkins, C.E.; Isaac A. Hopper, Builder and Contractor; Chas. Warren Hunt, C.E., Secretary American Society Civil Engineers; Geo. E. Weed, Supt. Morgan Iron Works; Stevenson Taylor, C.E.; John Henry Deeves, Builder and Contractor; J. S. Coleman, Contractor; Drew King Robinson, of Robinson & Wallace, Contractors; R. S. Gillespie, C.E. These gentlemen listened to the testimony presented (all parties interested in the case were represented by competent counsel), the proceedings were carried out through the best parts of two days (the jury visited the wreck the afternoon of Monday last), and the verdict returned by them was the following:

"That the said Pious Baum came to his death, on the 13th day of December, 1898, at Avenue A, between 20th and 21st streets, by asphyxiation by drowning, caused at the time and place aforesaid, on the premises of the Consolidated Gas Company, by rupture of new gasholder tank, thereby releasing a large volume of water contained in said tank, and occasioned in a manner unknown to the jury.

"We find that the plans and specifications prepared for the construction of the tank in question were in accordance with the standard practice by which numerous other tanks of similar character have been constructed, and which have been in use for a number of years.

"We also find that the construction and materials of the said tank were in accordance with the plans and specifications, and that the workmanship thereon was of good character.

"In view of the fact that neither the design nor construction of such gasholder tanks is under the official supervision of any city department, we recommend that all such work shall in future be subject to proper municipal supervision and control."

This verdict may be satisfactory to the jurymen, but we doubt if it will prove satisfactory to anyone else; and least of all will it be received with satisfaction by constructing gas engineers the world over. More especially will the latter repel the thought that tank and holder construction will be better done when put under the supervision of municipal engineers than when altogether left in the mutual custody of those who erect such vessels and of those who buy them. To say that the verdict is a disappointing one (especially in view of the engineering capacity of the men who composed the jury) is to put it in the mildest way; for no one is a bit the wiser now over the cause of the collapse than he was at 6 P.M. on the evening of December 13th. In the testimony taken (which we hope to print in full next week) quite some support was given to the theory that the rupture was caused by the malicious use of a high explosive.

NOTES.—The proprietors of the Bridgeton (N.J.) Gas Light Company promise that within the year the selling rate will not exceed $1 per 1,000 cubic feet. The ruling price is $1.10.——Governor Roosevelt has appointed James Trow Alexander as inspector of gas meters for the State of New York. He succeeds James L. Stewart.——At the annual meeting of the Cleveland (O.) Gas Light and Coke Company the following officers were elected: Directors, D. P. Eells, J. H. Morley and C. H. Beardslee; President, M. S. Greenough; Vice President, J. H. Morley; Secretary and Treasurer, C. H. Beardslee.——Receiver Tinsley's mission in connection with the affairs of the Macon (Ga.) Gas Light and Water Company is about at an end. The rehabilitation of the Company is completed, and the outlook is that Mr. H. T. Powell will be chosen President. This mention would be incomplete were it not stated that Mr. Tinsley's receivership was marked by honesty, capacity and success.——At the annual meeting of the Warren County Gas Company, of Phillipsburg, N. J., the officers elected were: Directors, John Franks, David Meixsell, Daniel M. Davis, Andrew Smith, Michael Kenney, D. I. Seifert and Samuel Thomas; President, John Franks; Secretary and Treasurer, David Meixsell.

[Prepared for the JOURNAL, by Mr. F. Egner.]

Plant for Obtaining By-Products at Coke Works.

Concerning this subject, the *Journal fur Gasbeleuchtung* publishes an article, by Mr. Rudolph Terheast, Chief Engineer of the Kölnischen Maschinenbau Gesellschaft, from which is abstracted the following interesting statement: Passing the introductory remarks and explanations, and confining this report to such matters as seem to be of use or interest to the readers of the JOURNAL, it is seen that Mr. Terheast stated that coking works nowadays, in addition to coke, tar and ammoniacal liquor, also have a considerable surplus of gas. The American reader can satisfy himself as to the real value of this "surplus" if he is so fortunate as to have a copy of General Andrew Hickenlooper's book on "Fuel Gas at Cincinnati;" but in the article under consideration it is said that a plant in Westphalia, containing 60 coke ovens (size and style of ovens not given), has a surplus of 847,536 cubic feet per 24 hours, or enough fuel to heat steam boilers with 4,036.5 square feet of heating surface. Calculating this in value of steam coal, and assuming that 3,531.4 cubic feet of gas equal 192.9 pounds of coal (or about 1,000 cubic feet of gas to 54.6 pounds of coal), this would give a value of the surplus gas equal to 46,297 pounds of said coal. This gas, the author remarks, can be also used for illuminating purposes instead of heating steam boilers; but in such case it must be passed through purifying apparatus similar to that used in commercial gas works, and it must also be carbureted if used direct; but the carbureting may be omitted if the gas is to be used with Welsbach burners.

The carbureting of this gas, by means of the vapors of hydrocarbons, can be accomplished at the coke works in a simple manner, after extracting the commercial benzoles from the tar, by means of the still remaining oils, which latter offer the advantage that they are not so volatile and are quite cheaply obtained.

Assuming that the consumption of gas per inhabitant per year will average 1,765.7 cubic feet, we find that $\frac{847{,}536 \times 180}{1{,}765.7}$ = (neglecting the fractional part) 86,000; or, in other words, that the surplus mentioned before would be sufficient to supply a city of 86,000 inhabitants.

The reader's attention is directed (especially if he is a student) to the multiplier 180 used, because it appears to be assumed by the author of the paper that that figure represents the multiplier by which the annual make or sendout may be arrived at, if we know the maximum make per day. Others have assumed 200 to be nearer the true figure. Taking, however, the figures of Mr. Terheast, and applying the rule, then 847,536 (make per 24 hours) × 180 = 1,525,564,800 cubic feet per year. Now right here is where the author of the article quoted from seems to have made a mistake. For example: The average figure of consumption per inhabitant may be all right, and so may be the constant 180, and the *daily production of gas from the 60 coke ovens, which to be profitable must be kept going constantly, producing every day their surplus of gas*, be it in December or in July; but even the student in the first stages of gas engineering knows that the consumption of gas varies greatly with the seasons. For instance: The monthly sendout from a large Western gas works was 5.44 per cent. in July, and 11.82 per cent. in December, of the total for a certain year. For certain days of the year the difference in per cent. is still more marked, not to mention dark days occasionally; and quite a chapter could be written upon the pros and cons entering into that subject; but it would seem that enough has been shown to prove that the rosy hues of Mr. Terheast, as given in his really interesting article, are not altogether well grounded.

The editor of the German *Journal* remarks: "A plant of this kind has been for some time in operation at Halifax, and we shall give it our attention in the near future." It is hoped that the operations at that plant may be thoroughly ventilated, and then probably a further confirmation of the facts published in the book by General Hickenlooper will be found. Returning to Mr. Terheast's article, the latter informs the reader that much depends upon the proper method employed in the distillation of coals, as to the quality of coke produced. This is shown not only in the appearance, but particularly in the solidity or weight of the coke. High heats are not to be recommended in coke ovens which are also expected to give good results with other by-products, such as tar and ammoniacal liquor. The too rapid extraction of gas and coking of coals lead to porous, less solid coke, and also materially affect the tar. Tar produced by means of very high temperatures contains more benzol and toluol, but also more naphthaline and other fixed constituents, while the tar produced at low temperatures is not so heavy, and contains principally hydrocarbons of a more volatile nature. This was evidenced when certain supposed improvements were made to ovens by which the temperatures were increased.

Mr. Terheast recommends 48 hours' duration per charge as the most suitable within certain limits of coke oven dimensions, and adduces the following results in support of this. In ovens in which the charges consisted of 15,432 pounds of Westphalian coal (duration of charge 48 hours) the results obtained were, per ton :

Coke, from dry coal.....	76.97	per cent.
" wetted coal.....	69.63	"
Tar, from dry coal	2.113	"
" wetted coal.....	1.905	"
Sulphate of ammonia from dry coal ...	1.16	"
" " wetted coal	1.04	"
Ammonia water, from dry coal.....	23.63	"
" " wetted coal...	21.38	"

and 23.92 pounds of benzole per ton, when by other methods only about 6 pounds of benzole were obtained. He concludes by remarking that although slow coking requires a larger expenditure of money for ovens in the first place, yet the results are so very much better in every respect, more especially in the yield and value of the by-products, that such a system is to be preferred to others where the coking is accomplished in less time.

Why some Small Electric Light Plants do not Pay.

By Mr. J. R. Cravath, in *Electrical Engineer*.

To the men who have always devoted their attention to the affairs of large lighting plants, the close figuring and attention to minute matters that is necessary in the management of electric light plants in very small towns are rather amusing, and it is apt to be thought, after a brief consideration of the matter, that the electric light business in a small place is a good thing to keep out of. Nevertheless the fact that there are numerous plants in towns of less than 3,000 inhabitants, and that they still continue to be built, and that there are many of them paying good interest on the money invested in them, goes to show that the general assumption sometimes made that no plant in a town of less than 2,500 inhabitants will pay, is far from the truth. As a matter of fact there are plenty of paying plants in towns of 1,200 to 1,500. My observation has led me to believe that where plants do not pay in prosperous towns of 1,500 and upward, it is usually not so much the fault of the technical or engineering end of the plant as it is of the common-sense business end. To be sure there must be a knowledge of the technical end combined with the business management, but the failure to pay dividends is usually fully as much or more with the business management than with any engineering defects in the plant, for in such small plants the engineering part is "cut and dried" practice as it were. However, as there are some inexcusable engineering blunders made even in such small plants, and as they are usually made when the plant is first constructed, a discussion of why some small electric light plants do not pay can only be entered into fairly by discussing both the engineering and business management from the time the plant is first financed to the time it is fairly in operation.

One of the first common mistakes in building a plant in a small town is to start with too little cash in the company treasury, or at least not enough provided for to properly get the enterprise on its feet. It should never be forgotten that in starting to light a small town, as in many another business enterprise, it will take some time to develop the business. While, after a year or two of operation the returns should be considerably more than the ordinary 5 or 6 per cent. on an investment, the first few months will not do much more than pay the operating expenses, to say nothing of interest on money borrowed to build the plant with or bills for construction material from electric supply houses. The promoters may think that if they can only get together money enough to get the plant started, somehow they will be able to pay for it out of the earnings. That is all very nice providing they can borrow money on long time loans and borrow enough to pay for the many expenses in the way of extending lines, adding new customers and paying interest the first few months after the plant starts. By far the most satisfactory way, however, is to start with enough paid in stock not only to start the plant but to pay for extensions and improvements for a year or two after it starts. In other words, put the cost of construction where it belongs and pay for it out of the capital stock of the company, instead of loading it on the operating expenses of the first two years and giving the whole enterprise a black eye both in the eyes of stockholders and public, because it does not pay expenses. Of course, theoretically, it makes no difference where the money comes from to pay for the plant, whether out of operating receipts or paid in capital. Practically, the gross receipts will not be more than enough to pay a small interest on the investment at first, if they are even enough to do that, and an attempt to not only pay running expenses but construction expenses out of gross receipts is foredoomed to failure, and the moral effect of this on the standing of the enterprise, not only among outsiders but among stockholders, is something to be avoided. Let there be money enough to do the thing right from the start, let it be understood among stockholders that returns are not to be looked for the first few months, but may be counted on with certainty once the company is fairly started, and we start out with little chance for the dissatisfaction and loss of confidence that sometimes handicap the small plant.

Once the financial problem is out of the way and money provided for, there are a number of ways, both successful and unsuccessful, to go about building the plant, as the results all over the country to-day testify. Here, too, a level business head is needed as much as anywhere else. We see statements often in the technical press from which one would gather that it is only necessary to hire a consulting engineer and the work will be done perfectly. Contracting firms would make one believe that it is only necessary to give them the contract for the whole thing and all will be right. Then there is the man with second-hand machinery who will tell you how to do the whole thing if only one will purchase of him. Now, I am not prepared to say that any of these methods is all right or all wrong. It takes a conservative, level business head to see the correct way whichever method is pursued. It is surely not good business to deal with technical matters one is not familiar with, without the unprejudiced advice of some one conversant with such matters, nor is it good business sense to seek such advice without being sure it is honest and competent. Neither is it always good business sense to attempt the assembly of all the apparatus that makes up a plant, when reliable contractors skilled in the business can be found to undertake it, at a reasonable price. Last of all, I certainly do not consider it a necessity at the present time to purchase new apparatus all through for a small village plant. Second-hand apparatus, however, is something which should only be "taken in very small doses, and under the advice of a competent physician." In this matter of second-hand apparatus there are many things to be considered. It is usually the case that cheapness and reliability stand above all else in the very small plant. In such plants the alternating system will be generally used, and as the generating outfit will comprise one engine and one dynamo it is important that they be in such condition as to be able to give regular service with no shut-downs for repairs.

Owing to the enlargement of many plants, a large number of second-hand alternators of small capacity have been thrown on the market at a very low price. Many of these are almost as good as new and offer the small plant a chance to make a considerable saving in investment with practically no drawbacks, if the machine is carefully selected. Second-hand engines can also be bought that will give excellent service if thoroughly overhauled as to all bearings, pistons and valves before being put in service. Leaky insulation in the dynamo and leaky valves and pistons in the engine are the things to be looked out for mainly in the purchase of these machines second hand. As to second hand boilers, the electric light man should be exceedingly wary and only purchase after a rigid examination as to quality of metal and incipient defects. Most boilers are not worth resetting after a few years' use with the scale producing water that abounds in most parts of the country. While an engine or dynamo can usually be repaired or overhauled in a few hours between runs, boiler repairs usually require several days, and it is therefore important that there be no boiler repairs if the plant is to run with one boiler. And this leads up to a mistake that is often made in the construction of a small plant, namely, the attempt to get along with one boiler in a locality where the water scales boilers very badly. It is comparatively safe to count on one boiler as one engine and one dynamo, if the water is good and does not leave any hard scale on plates and flues, but it is flying in the face of fate to count on obtaining unbroken service day after day for years from one boiler if there is any tendency on the part of the water used to form hard scale. Many a plant has come to grief from this cause. If one boiler only is put in the tendency constantly is to neglect the thorough cleaning of it, and in fact there is not time between daylight and dark to cool down a boiler so that it can be properly cleaned. Some inaccessible place will get heavily coated and then it is only a question of time until leaks and shut downs will follow. Therefore, always make provision for putting in two boilers even if the plant is to be started with but one. It usually costs no more to build with a view to increase of boiler plant, and yet it is extremely common in the smallest plants to see no provision whatever made for it and an arrangement of building and coal storage which makes the addition of another

boiler a matter of turning things wrong side out to accomplish it. To return to the consideration of how far it is best to invest in second hand apparatus, the strongest temptation of all will be to save investment by getting all second hand transformers. A great many good engineers familiar with all the modern ideas as to the great core loss in aged transformers will hold up their hands in horror at the mere mention of the possibility that second hand transformers could be used. There are no doubt many transformers to be had both new and old that are expensive at any price. There are, however, many transformers of good make thrown on the second hand market because of the increasing custom of bunching customers on larger transformers as practiced by large plants. These discarded transformers may have lost some efficiency through the ageing of the iron, but the probabilities are that they are still more efficient than some makes of new transformers, and certainly the regulation is as good as it ever was.

A good second hand transformer is certainly to be preferred to a poor new one. For the few moderate sized transformers that run the store lights in a small town the matter of efficiency is not of great importance because the transformers are few in number and are run most of the time near full load, as the smallest village plants only run the first half of the night. For the scattered residence lighting, however, efficiency is of great importance, because it is impossible to bunch many customers on the secondary of one transformer, and as there must of necessity be many small transformers, the leakage current and watts lost in heating transformer iron will be considerable. It should not be forgotten, however, that the short run (averaging 6 hours per day) of the small village plant, tends to make the matter of core loss in transformers relatively of less importance than in a plant run 12 or 24 hours per day.

In my opinion, it is safe and good policy to buy second-hand transformers, provided they are put through the same tests and made to answer to the same specifications as new ones would be.

The transformers that go into small plants are rarely tested in any manner, but at the present day there is no reason why they should not be put through some simple commercial tests before being accepted, since the necessary instruments are now within the reach of all plants at a reasonable price. No transformer should ever be put on any line that drops more than 3 per cent. in voltage at its secondary terminals between no load and full load. This is easily tested at any village plant by measuring the voltage at the secondary terminals of each transformer with and without load, the primary voltage being kept constant. And I may say here that a portable alternating current voltmeter should be a regular part of the equipment of every plant of this kind, although as a matter of fact small plants having them are very scarce. Implicit faith is usually placed in the station voltmeter, and it is religiously kept at a certain point, regardless of what the line drop may be and regardless of what the error of the instrument may be, but this is another subject and I will speak of it later.

Each transformer, before being accepted and put on the lines, should be tested for core loss, that is, the constant loss of energy that is taking place as long as the transformer is connected to live lines. This can easily be done with an indicating wattmeter, of the kind used also for testing lamps. Several companies now make indicating wattmeters suited to this purpose. To test a transformer for core loss, it is only necessary to connect its secondary to the secondary of some other transformer already in operation on the lines. Then by connecting a wattmeter so as to measure the energy supplied to the secondary of the tested transformer and leaving the primary circuit of the transformer that is being tested open, the energy lost in the core of this transformer can be read directly from the wattmeter. A number of transformers can be tested in a very few minutes in this way. If the transformers are new, this core loss should not exceed 30 watts in a 20-light converter, 40 watts in a 30-light converter, 50 watts in a 40-light converter and 60 watts in a 50-light converter. A general rule on the smaller sizes which may make these figures easy to remember is that the core loss in watts should not be more than the capacity of the converter in lamps plus 10. If the transformers are second-hand and coal is cheap, these figures may be stretched a little, but there is no excuse for new transformers not being up to this standard, as many makers are doing far better than this. If an indicating wattmeter is not at hand, the core loss in a transformer can be tested with a common recording wattmeter such as is used for measuring current supplied to customers. This should be of low capacity (10 lights being usually the lowest obtainable) and the test, to be correct, should cover several hours. As wattmeters are liable to run slow on such a small load as the leakage current of a transformer, it is best to put a load of lamps on the wattmeter in addition to the transformer. For example, if it is a 10-light wattmeter, connect a load of 9 lamps to it and note the amount of energy supplied to the lamps in a certain time. Then in addition to the 9 lamps connect the secondary of the transformer to be tested in multiple with the lamps, and note the amount of energy consumed for exactly the same length of time as in the first case. The difference will be the amount of energy lost in the transformer provided the voltage in the same during both tests, and the lamps have not had time to change with age. In order to be sure that these two chances for error are eliminated it is well in the small station to make the first test covering about 5 hours on one day and the second the corresponding 5 the next day. If the station voltage is the same in both cases, as it should be for corresponding hours on week days at the same season of the year, and if the same lamps are used in both cases, this test should give fairly correct commercial results. Neither the lamps nor the wattmeter will change much in the course of a few hours and therefore the comparative results are not rendered incorrect, as they might easily be if weeks or months should intervene between the two parts of this test.

Another most important point to be observed in accepting transformers, especially if they are not new, is the insulation. It certainly is not good business policy to accept and put on the lines, transformers that will burn out with the first thunderstorm, or perhaps get a leak between primary and secondary that will result in killing or severely shocking some unsuspecting customer. And yet it is safe to say that in the majority of alternating plants there are transformers that are a constant menace to persons handling lamp sockets on the secondary circuit. That the writer is not now in the happy hunting grounds on account of a leaky transformer of this kind, is due more to good luck than to any more rational cause. Few men connected with the smaller plants realize the danger from this source. One good sized personal injury lawsuit would cripple a small electric light company so it could never get on its feet again ; and yet transformers are constantly left on the lines until they actually burn out, without any effort to find out whether they are in a condition dangerous to customers, when a simple monthly test of each transformer with a magneto would take no more time than reading the meters, and would weed out defective transformers. To be sure a transformer will be very far gone before even a powerful testing magneto will ring through between primary and secondary, but by testing often enough the dangerous condition cannot exist very long. Before putting a transformer up, large stations now make a severe test as to the ability of a transformer to stand high voltage between the coils. To make this test, special high voltage transformers are required. Specifications recommended by various authorities as to the voltage a transformer shall be able to stand between primary and secondary vary considerably. Ten thousand volts (as sometimes specified), after the transformer has been heated by its rated load for several hours, is a rather severe test for a 1,000-volt transformer. Five thousand volts for a 1,000-volt transformer is another specification, and this is certainly none too severe, while at the same time it will let nothing inferior pass. If a small company feels that it can not afford a special high voltage transformer for such tests, it can at least run its transformers for six hours at full load and then apply 1,000 volts between primary and secondary terminals for 15 minutes.

It is also easy to note whether in this 6-hour run at full load the temperature of the transformer rises more than 70° F. above the surrounding air, and if it does it is not worth putting in service. Now there is nothing about any of these tests spoken of that cannot be done around a small plant by the men already employed if they are properly directed. They take very little time when worked in with the nightly station routine, and it is nothing more than good business management to know the kind of apparatus a company is getting for its money, and whether such apparatus is worth buying and fit for use.

Before leaving the electrical engineering part of the construction and operation of a small alternating plant, I want to call attention to the most remarkable method, or want of method, in vogue securing the proper voltage at the lamp terminals. Upon going into one of these plants one usually finds an alternating current station voltmeter of uncertain age and accuracy run from the secondary of a transformer. Now this transformer may be a special station voltmeter transformer, but it is just as liable to be any kind of transformer that happened to be handy, perhaps partly loaded with lamps in the station, perhaps not. Now, it is likely to make anywhere from 2 to 5 volts difference with the absolute accuracy of the voltmeter as indicating the correct primary station voltage, whether it is run off its own transformer or some common transformer partly or fully loaded. Not only is this possibility of error ignored, but the drop in line, transformer and secondary wiring is ignored, and the station voltmeter is kept constantly at a certain point

without regard to the load that is on. It may have been very nice as a theory in the early days of alternating current distribution that the loss in distribution was too small to be counted on, but it does not work in practice. On small systems there is usually a drop of from 2 to 5 per cent. in the primary lines between station and transformers at full load. The transformer itself will cause a drop of 2 to 3 per cent. between no load and full load, and the secondary wiring is usually calculated (if calculated at all) to give 2 per cent. drop. We have then approximately between no load and full load the following losses to provide for at the station :

Primary circuit.....	4 per cent.
Transformer drop.....	3 "
Secondary drop.....	2 "
	9 "

This drop of 9 per cent. would call for a pressure of 1,090 volts at the station, but as a matter of fact 1,110 will be needed because the real ratio of conversion of all transformers falls somewhat short of the nominal ratio. Thus transformers built to transform from 1,000 volts to 100 will give from 97 to 99 volts on the secondary when the primary voltage is 1,000 and there is no load on the secondary, and from 94 to 96 volts with the secondary loaded and primary pressure 1,000 volts. The proper way, of course, is to always keep the primary voltage 2 per cent. higher than the normal ratio of conversion calls for.

Assuming, according to the foregoing figures, that the losses in primaries, transformers and secondaries is 9 per cent. on full load, the proper station primary voltage should be 1,020 at no load, 1,065 at half load, and 1,110 at full load, other loads in proportion. Now, it is evident that with a station voltmeter of the kind described, that no one knows the accuracy of, and which really gives no indication of the true primary voltage, it is like going in the dark to try to regulate the pressure by it. There are evidently so many chances of error by it that the only safe way in most cases is to have a good portable alternating current voltmeter, not only for checking the accuracy of the station instrument, but for actually going to the consumers' lamps and determining what station voltage, as indicated by the station voltmeter, will give the correct lamp voltage at different loads. A good portable voltmeter for this purpose is by no means an unnecessary refinement, as it is the only sure way of keeping lamps at their proper voltage. Lamps run below their voltage give a poor light and are a very poor advertisement for the electric light in the small towns where gas machines and powerful kerosene burners put up strong competition. On the other hand, the excessive lamp renewals with too high a voltage will pay for a good many portable voltmeters. The case is no better if the customers pay for their own renewals, for they will object to this expense very vigorously.

The adjustment of meter and contract rates is a matter requiring much good judgment and an intimate acquaintance with the electric light business, as it runs in small towns; for a mistake in the beginning is very difficult to remedy. Never put the rates very low with the idea of attracting a large number of customers without first considering how many customers it is possible to get, as shown by the experience of plants in similar towns. In a small town, unlike a large city, there is a very limited number of possible customers. The majority of the stores will become customers in time if the service is good. Among the residences, those able to afford electric lights in a small town (unless it is a rich suburban town) are very much in the minority. The income possible is then limited, and the company should see to it that in the effort to compete with gas and kerosene they do not put rates down to where it will always be an impossibility for the plant to pay. It is now generally accepted that the only proper way to sell current from a large plant is by meter; but what is to be done in a small town where there are numerous customers taking from two to seven 16 candle power lamps each. To buy, install and look after a 10-light meter for each one of these is evidently an unnecessary expense, since most of these customers are small stores and places where the lights are used a definite number of hours every day, and it is easy to calculate just about how much current will be used, and charge accordingly by contract. For all other customers, however, where the demand for light is intermittent, the meter is the only thing and the contract rate a snare and a delusion as far as the company is concerned. Residence lighting by coutract is one of the best ways to burn money the writer ever ran across. The man with 20 lights in his residence who "ordinarily wants only two at a time," somehow forgets to turn off the other 18 enough of the time so that his load is fully equal to that of the stores which pay several times as much per month.

Designers of small stations do not sufficiently realize the value of labor-saving arrangements of building, boiler, etc. Labor is the largest item in small plants, and it is often the case that differences in the arrangement of the plant will constitute the difference between getting along with one man or hiring two. Builders of small steam plants have a favorite way of arranging to have the coal dumped first into a store room adjoining the boiler room, from whence it must be run out in a wheelbarrow in front of the boilers. They also have a fondness for making the space in front of the boilers very limited, so that not much coal can be put there at once, and the fireman's operations in general are impeded. Then, too, according to this creed, whenever possible, the dynamo room, stoke hole, pump and steam gauge should never be put in any handy relation to each other. The engineer that runs the plant when he is not getting out coal from the storage or firing and cleaning fires in the limited room before the boilers, will be kept from getting lazy by chasing around Robin Hood's barn to look at the voltmeter or start the feed pump. The fact is, the moral effect of such a poorly arranged plant is enough to destroy all sense of discipline or responsibility on the part of the man running it, to say nothing of his inability to look after the plant as it should be looked after, simply because of such unhandy arrangements. And right here it may be said that no matter how limited the force employed around a plant, it is important to the financial success of the undertaking that everyone connected with its operation be made to feel a strict sense of discipline as regards correcting immediately any defect that could possibly develop to an extent to cause the shutting down of the plant. As financial reasons prohibit an investment in duplicate machinery to a large extent in small plants, it is of greatest importance that everything be kept in such perfect condition that breakdowns never occur. The steam plant of an ocean steamship is expected to make its run across the Atlantic, covering from one to two weeks' time, without a hitch or shut-down of any kind. It certainly is not asking too much to expect a small electric light plant to run as regularly as clockwork a few hours every day. But it requires eternal vigilance to do it. Breakdowns and poor service usually originate with the business management of a company. If the men find that their carelessness in not reporting or remedying the slightest troubles is overlooked, or if, as is often the case, reports of incipient troubles are ignored, or the ordering of supplies to correct them is delayed, it will only be a short time until everyone about the plant loses all strict sense of responsibility. The personal equation figures very largely in the reliability of the service given by any plant. Dirt and disorder should never be put up with, not so much on account of the injurious effects of the dirt as because of the general demoralizing effect such a condition of affairs and the resultant carelessness as to details. The weighing of all the coal used as it is fired is not practicable in the small plant because of the labor involved, but it is well occasionally to have a test night or two and weigh all the coal, and if possible all the water. Such tests, together with monthly averages, will help determine the best coal to buy, for the best coal is not always the cheapest any more than the cheapest is always the best. There is usually fully as much chance for fuel economy around the boiler room as anywhere, by keeping boilers free from scale, and flues free from soot, properly heating feed water and careful firing so as to avoid leaks of steam through the safety valve and of air through the fire doors.

Finally, I may give as one of the principal reasons why some small plants do not pay is that there is not enough in the business to command the services of a very high priced man in any capacity. While plenty of men can be found who can do the manual work around a plant it is not easy to find men who are capable of taking charge of everything about the plant, and who will do all the manual labor necessary, because such a quality of man can usually find equally paying positions in some larger plant where they can get work more to their taste. The result is that often the plant is managed jointly by some officer of the company who knows nothing by previous experience of the electric lighting business, and by some hobo who does the manual labor and who is equally ignorant of the electric light business. The combination is always an unhappy one for the stockholders. It goes without saying that there should be someone connected with the enterprise who has had some experience in the business, though it matters not much in what capacity, whether as consulting engineer, officer and part owner, or as operating electrician or engineer.

At the annual meeting of the shareholders in the Equitable Gas Company, of Pittsburg, Pa., the officers chosen were: Directors, Reuben Miller, James Hemphill, Robert B. Brown, Chas. H. Zey, J. Stuart Brown, Frank B. Robinson, Jacob T. Keil, Leopold Vilsach and William H. Alldred; President, Robert B. Brown; Secretary and Treasurer, William H. Alldred.

[Concluded from page 114.]

Notes on the Distribution of Alternating Currents.

By Mr. S. E. T. Ewing, in *Elec. Engr.*

The equipment of a sub-station should be as complete as due regard to cost will allow. The value of disconnection and fusing points which can be readily made use of in all weathers is very great, and wherever a main approaches closely to a sub-station it should be taken in and out again through a pair of fuses or connectors. Of course, in really large sub-stations attendants are always present for the purpose of switching transformers in or out as the load varies, and in such cases there is a complete equipment of switches and fuses, ammeters and voltmeters, and arrangement for cross-connecting the various mains; but there are not many cases, apart from the large alternating supply undertakings in London, where the constant presence of an attendant is justified by the saving in magnetizing losses. In the smaller class of sub-station usual in provincial towns, the only real indispensables are primary and secondary fuses to each transformer, and a maximum demand meter on the low-tension bus bar. Probably the safest form of high-tension fuse for use in sub-station work is that consisting of an earthenware tube made in one with a stout handle. The fuse wire passes through the tube from one terminal of the handle piece to the other, and contact with the basepiece is made by spring clips. These fuses can be used as switches with perfect safety, provided rubber gloves are used as a protection against possible surface moisture, and can be relied on to break the circuit without arcing under all circumstances. In the arrangement of the equipment all high-tension work should be separated from the low-tension, preferably on different walls, the high-tension being on the wall farthest from the manhole and railed off. No one except the distributing engineer and the foreman on mains should be allowed to go inside this railing, save when working under direct supervision, under penalty of dismissal. All connections should be simple enough to be followed at a glance, and all high-tension should be painted a distinctive color, red being the best.

It is often the case that when a system of mains and sub-stations is put down the arrangement of the sub stations receives very little attention from the contractors, being left to the discretion of the engineer in charge of the main laying, who has probably no experience of the actual needs of distribution work, and mistakes are made which it is difficult or impossible to rectify afterwards. The writer has seen several which, from being too small in the first instance and badly arranged, have become crowded, complicated, and altogether places to be avoided. On the other hand, when they have been designed and carried out by the men who have to use them, or, at any rate, by people having experience in that particular class of work, their value is very great. Probably no part of the distribution equipment repays so well any extra care bestowed on their design in the first instance.

Very many automatic contrivances for switching transformers in or out as the load on the sub-station varies have been tried, and still more have been patented and never used. The difficulty of getting a small increase of current to operate a number of switches, requiring a considerable amount of force to open and close them efficiently, is very great, and supposing this to be successfully done, there is the well-founded prejudice of station engineers against leaving so critical a matter in the hands of automatic mechanism to be overcome. The only piece of apparatus of this kind that is working successfully, as far as the writer knows, is a switch which cuts the transformers in when required, but has to be operated by hand to cut them out again. This, however, fulfils the main desideratum, for the load may come on at any time during the day, but can be relied upon to fall off at a certain time in the evening, so that the attendant can time his visit accordingly. An automatic cut-in of this kind should be of great service in sub-stations not quite important enough to justify the cost of an attendant all day. Although in the majority of towns with an alternating supply no expense of this kind is repaid by the saving in magnetizing, yet it is nearly always possible in the central districts, where the load consists mainly of shop and office lights, to cut out a considerable number of transformers in the summer. A transformer which is not alive may be left in a warm, dry sub-station where other transformers keep up the temperature of the air, but it is never advisable to cut out of circuit and leave for more than a day or two a single transformer in a cellar or chamber. If so left, it is very likely to break down the next time the current is put on.

In deciding the positions and distances apart of proposed sub-stations in a hitherto unsupplied area, the chief guides are the secondary supply voltage and the probable lamp density. As a first approximation, with, say, 3-wire distribution at 200 volts between the outers, a distance of 400 yards apart might be fixed upon, this distance to be diminished to 300 yards in districts where the lamp density is likely to be high, and increased to 800 or 1,000 in more sparsely lighted residential districts. Then an inspection of the streets will enable the most favorable points to be fixed on. A corner where a number of mains must cross will serve to locate the first position. Wherever possible, it is a good plan to arrange that the manhole will come just out of the main thoroughfare in a side street. Manholes at a crowded corner which are frequently being opened are a great annoyance to the public and anything but a judicious advertisement of the supply.

Distribution Mains.—This brings us to the next stage in the supply system, viz., the low tension distribution mains. At the present time the most popular cable for this work is undoubtedly the armored concentric, and, considering the very large amount of this type now successfully in use, it would appear to be the best all-round cable to be obtained. Probably the worst point about the use of concentric cable for distributors is that every service connection necessitates cutting the outer conductor, and though this need not interrupt the supply if the main be fed from both ends, yet when a number of connections have been made the resistance of the outer conductor depends upon a number of clamped and soldered connections. The connection boxes always have ample contact surfaces, and no difficulty is likely to occur with moderate currents, but in a large main carrying several hundred amperes there is a certain risk. When armored distributers are used they are generally buried in the roadway, to save the cost of making good the pavements. Hence a fault on these cables, with their numerous inaccessible service joints, the exact position of which cannot be located within 2 feet or 3 feet, is often a most lengthy and troublesome business. For this reason, the use of an unarmored cable, laid in a conduit under the pavement, offers great advantages. When a connection is to be made, the conduit is cut and the joint box put in. Then a small brick box with an inspection cover is built round it. This adds decidedly to the cost of the service, but renders the subsequent maintenance a very much easier matter, for the main can be rapidly tested in sections between the service boxes, and a faulty length drawn out and replaced. On the other hand, for the actual service main—that is, from the street main to the house fuse—an armored cable is better than a lead covered concentric or rubber cables in a pipe. The conduits in the street may become at times charged with water, lighting gas and sewer gas, or pungent smoke from a burnout on the cables (the latter will travel a surprising distance along the pipes); and to lead a pipe from these conduits directly into a shop or cellar is to expose the premises to these nuisances at some future time. The armored cable obviates this, at the same time costing less than cables in a pipe. Frequently, too, it is difficult to get a straight run into premises from the street box, and the cable, being flexible, requires less labor for trenching and fixing.

In laying distributing cables at the commencement of an undertaking or in new areas, it is a matter of great difficulty to arrive at all closely to the probable demand at a future date. Large customers for motive power are apt to spring up in unexpected quarters, properties undergo improvement, with the usual result of largely increased demand, and sometimes an apparently promising street quite fails to come up to expectations. To lay a new and heavier distributer alongside an older one is a very expensive proceeding, unless copper strip is used, and to feed the distributer at more points is very likely inconvenient. Therefore, in districts of probable high lamp density it is certainly well to put in ample section in the first place. A little too much copper in one street is better than low voltage in another. In residential districts, however, where lighting is sure to be sparse for some time, and the distances considerable, it is often more economical to use double rubber cables, and to exercise far less generosity in section, for if a main gets loaded up it is not a difficult matter to draw it out and replace it with a heavier one. The old cable is sure to come in useful for short connections to house meters, transformers, and so on. In residential districts one customer for every 50 yards of main might easily be the maximum possible number, whereas in business areas five in the same distance, each with the same demand as the private house, might be a moderate estimate of the probable future demand.

Opinions are greatly divided as to whether the whole area of low tension supply should be connected up to form one network, whether there should be two or three separate networks, or whether each sub-station should feed its own radial system. If the whole system forms one network the voltage over the whole becomes more uniform. If a fault occurs the whole system combines to burn it out, but at the expense of disturbance over the whole system. In any case the following

precautions are advisable and are generally adopted to secure continuity of supply in the event of breakdown. All transformers should be connected up with their similar terminals to the inner and outer mains respectively, so that they may run in parallel with the rest of the system when occasion requires. At a number of points where mains intersect there should be network boxes for two, three or four ways, as the case may be. All makers of cables supply suitable boxes, which enable connection and disconnection to be rapidly made. As far as possible, every street should be fed from both ends, or be capable of being so fed from network boxes. If this principle can be thoroughly carried out, it would certainly appear the best plan to split up the area into small networks, so that two or three sub-stations only supply each network. The effects of a heavy short are thus restricted, and if the repair necessitates the disconnection of a main from the parent network, the adjacent network can be connected on to the end farthest away and feed right up to the fault as soon as that has been located and cut out.

If transformers which differ considerably in design or which have slightly different secondary voltages are used, there will be a certain amount of waste current circulating between them, and they will take up the external load very unequally. Further, the impressed high-tension voltage may be sensibly different at different sub-stations at the time of heavy load, producing the effect of different secondary voltages on otherwise exactly similar transformers. Thus, the share of load which a transformer or bank of transformers will take cannot be confidently predicted, and the maximum demand meter is of great value in giving warning of any serious inequality or overloading.

No system of mains is free from the possibility of faults, and in spite of the great all-round excellence of modern cables, most distribution engineers find a good deal of their time is taken up in locating and repairing incipient or actual "earths" or short circuits. A great deal has been written about ingenious methods of locating faults, based on the common practice of telegraph engineers, but these methods are very little used, simply because they require delicate instruments and a good deal more time and care than the results justify. If the network is well provided with disconnecting points, either in sub-stations or boxes, a Silvertown or other simple testing set and a keen scent are the most useful aids when cables in conduits are used. If plenty of power is available before the fuses blow, the results of a burn-out can generally be smelt for 50 yards along a conduit. In the case of a long high-tension feeder the matter is different. These can be isolated at both ends, and the standard station instruments used to make a careful loop test.

Improved Apparatus for the Laboratory.[1]

By Mr. J. L. Sammis.

Burette.—The frequent use of Mohr's burette with Geissler's glass stopcock during the past summer called the writer's attention to two points which, it was thought, might be improved.

The handle of the glass stopcock, as usually made, is turned toward the right. Right-handed persons usually find it easier to operate the stopcock with the left hand and stir or shake the titrated liquid with the right. In order to facilitate this, the stopcock of a burette was cut off and sealed on again with its handle toward the left. See Fig. 1.

In titrating, much care has to be exercised lest the mark upon the float should sink below the graduations on the scale of the burette. To render this impossible and to enable one to see more easily the scale and the titrated liquid at the same time, the tip of the burette was elongated to about 14 inches by sealing in a piece of glass tubing between the stopcock and the constricted extremity. This elongated tip was bent to the front and a little to the right just below the stopcock, and then upwards. Two more bends were so placed that the end of the tip was about 3 inches in front and 1 inch to the right of the lowest mark upon the 50 cc. burette. By this arrangement, with the stopcock wide open, not a drop of liquid will flow out after the liquid meniscus in the burette has reached the level of the end of the tip, which, as described, is just opposite the 50 cc. mark of the scale. If the tip be placed a little higher up, say opposite the 49 cc. mark, the instrument may be used with a float or without. The long narrow burette with the new tip can be held much closer to the table by the burette clamp, and the easy reading of the upper end of the scale is thereby facilitated.

Electric Heater Adapted for Use in Ether Extraction.—During the past year a large number of extractions with Sohxlet's apparatus have been performed in this laboratory. In order to continue this operation during the night time without the danger of fire, an electric heater was devised which could be put in operation by closing a switch and which kept the water at the proper temperature as long as desired. The heater (Fig. 2) is made of coils of No. 24, soft iron wire, wrapped upon a brass rod, and insulated from the rod and from each other by thin sheet asbestos. The winding was done rapidly by placing in the lathe chuck a brass rod 6 inches long and $\frac{3}{8}$ of an inch in diameter, laying a sheet of asbestos paper over it, and winding on the wire, keeping the turns about $\frac{1}{32}$ of an inch apart to prevent short circuiting. Having wound one coil, a second sheet of asbestos is put on, and a second coil wound on it, and so on until the desired resistance is obtained. The ends of the iron wire are soldered to short pieces of No. 12 insulated copper wire which serve to bring in the electric current. The cylinder thus made is slipped into a closely fitting tube of sheet copper and the ends of the latter are soldered on. A small hole or notch is left at one end of the copper tube through which the insulated wires pass. These copper wires are pushed through a narrow piece of brass tubing about 4 inches long, and the tubing is soldered to the copper cylinder in a position perpendicular to the axis of the latter. The heater is placed in a 4-holed water bath and the brass tube with the copper wires is pushed up through a small hole made in one corner of the top of the bath. The tube may be soldered to the edges of the hole. The ends of the copper wires are made fast to binding posts, screwed into a narrow strip of wood upon the front of the battery of water baths.

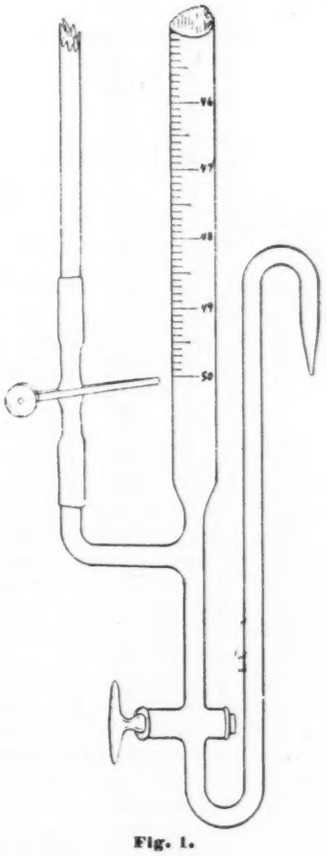

Fig. 1.

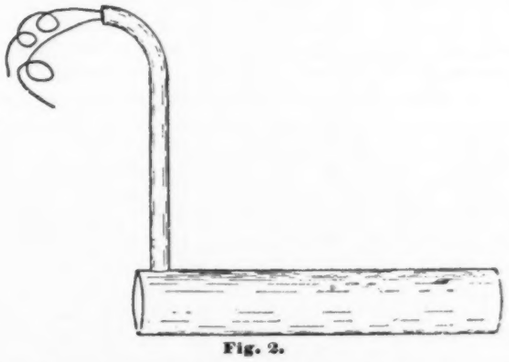

Fig. 2.

One heater is required for each 4-holed water bath, and the heaters are connected in parallel. The length of the iron wire in one heater is

1, *Jour. Am. Chem. Soc.*

70 feet, and its resistance when hot is 26 ohms. The potential difference across the ends of the heating coils is 52 volts, thus using 2 amperes of current and 104 watts per heater. The heat generated is sufficient to keep the water in the bath at 65° C., and the ether in the extraction apparatus falls from the condenser at the rate of 20 or 25 drops per minute. The currents from a storage battery and from a 125-volt dynamo have been used to run this apparatus with perfect success, and with little attention and no risk of fire.

Artificial Lighting (Gas and Electric) for Public Institutions.

By Prof. CARLTON LAMBERT, M.A., Royal Naval College, Greenwich, England.

The importance of a system of artificial lighting which shall be at once efficient, economical and healthy, renders a study of the relative advantages of the two illuminants, gas and electricity, in the light of modern developments, of great interest to those who are concerned in the working of our public institutions.

Were it not for the invention of Carl Auer von Welsbach, who, in 1887, taught us how to obtain from a cubic foot of gas eight times as much light as we had been accustomed to from our open burners, gas as an illuminant would have been almost entirely out of the field at the present day.

The Welsbach mantle has effected a great revolution in artificial lighting, and has made gas absolutely unapproachable at present by its competitors as a cheap illuminant. It consists, as is well known, of a delicate network of rare earth, thoria, with a 1 or 2 per cent. admixture of ceria. This is placed over a non-luminous Bunsen flame, the heat of which renders the mantle powerfully incandescent. The function of the gas is to generate heat, and that of the mantle is to transform the non-luminous heat energy into luminous light radiation.

It is curious that neither a mantle of pure thoria nor one of pure ceria is at all efficient for light emission, and the wonderful incandescence which is the result of adding less than 2 per cent. of ceria to a thoria mantle is difficult of explanation. It is frequently ascribed to a catalytic action causing great local intensity of combustion somewhat similar to that which induces the union of oxygen and hydrogen in the pores of spongy platinum.

Doubt seems to be thrown on this theory, however, by the fact, established by Le Chatelier, that the light emitted by the mantle is the same whether it is heated in the hot gases at the required temperature before or after they are burnt. Another explanation which commends itself to the writer is based upon the fact that the emitted waves of a pure thoria mantle are largely ultra blue, or too fast for vision, and those from a ceria mantle ultra red, or too slow. It is suggested that the admixture of ceria so loads the thoria particles as to tune down their vibrations into the bright range of the visible spectrum, and thus to make evident to the eye rays which would otherwise be invisible.

To whatever cause it may be due, the emissive power of the Welsbach mantle is certainly remarkable. The ordinary C mantle, which has been much improved during the last 5 years, and which is now in general use, frequently gives as much as 70 candle power for a consumption of 3.8 cubic feet of London gas, or an "efficiency" of over 18 candle power per cubic foot of gas burnt per hour. The writer has lately obtained from an ordinary C mantle the high efficiency of 20-candle power per cubic foot. And this is not by any means the best that can be done, for a new type of Welsbach burner is now coming on the market which, by a special construction, causes the gas to induce and thoroughly mix itself with almost the exact amount of air required for perfect combustion, and this without the aid of a chimney; thus a perfect Bunsen flame is produced, and very high incandescence obtained.

The writer's laboratory is at present lighted by one of these new burners, which is giving a light of 110 standard candles at an expenditure of 4.8 cubic feet of gas per hour, an efficiency ten times as great as that of good ordinary fishtail or batswing burners. This means that, with South Metropolitan gas at 2s. 3d. per 1,000 cubic feet, he is getting light at the rate of 110 candles for nearly 7¼ hours for a pennyworth of gas.

In a practical estimate of the cost of Welsbach lighting under everyday conditions it will be necessary to make some deduction from the figures above quoted, and to allow, not only for renewal of mantles, but for a gradual decline in their illuminating power. Assuming a lamp to be lighted for 1,500 hours per year, it is a good rule to allow for three mantles for the period, and to take the average life at 500 hours. A mantle will generally be efficient after much longer use (the writer has one which is still efficient and has been in daily use for five years, since September 27th, 1893), but the too long use of a mantle is not always an economy. During the 500 hours' life it is safe, in the writer's experience, to expect an average efficiency of quite 14 candles per cubic foot of gas, so that we may rely upon getting a mean of 50-candle power at the cost of 3.6 cubic feet of gas per hour.

At the Yarrow Convalescent Home, Broadstairs, of which the writer is a trustee, the building was originally planned for an electric installation, but inquiry having shown that the use of the incandescent gas light would result in a large annual saving, the electric scheme was abandoned, the engine, dynamo and accumulator rooms were otherwise utilized, and 156 Welsbach burners were fitted.

During three years to September 30th, 1898, accident and decay of the mantles have been covered by 704 renewals, or less than two per burner per annum. During the same period the expenditure on other upkeep was less than 4d. per burner per annum.

The dining hall for 100 children and attendants, which is 64 by 27 square feet in floor area, has four triple gas pendants, with 12 Welsbach lamps and "Cosmos" opal shades. Three burners are found to illuminate the whole hall sufficiently for ordinary purposes, and usually no more are lighted. The economy and general results of the Welsbach lighting have given great satisfaction to the trustees.

Careful domestic arrangements have probably made these results exceptionally favorable, and, therefore, in the general estimate of the comparative cost of gas and electric domestic lighting which follows, a somewhat larger cost of upkeep is assigned to the Welsbach system than has been incurred at the Yarrow Home.

London experience of electric lighting, where the current is retailed at about 6d. per unit (1,000 watt hours), shows that a glow lamp absorbing 64 watts gives, when new, a maximum light of 16 candles. In consequence, however, of the gradual deposit of carbon from the filament upon the glass, the light value falls off and an average of 14 candles is as much as should be expected during the useful life of a nominal 16 candle glow lamp. We will give the advantage, however, to the electric lamp and credit it with 16 candles.

When treating of the old system of open gas lighting it is assumed that the best No. 5 "Bray" burners are used, giving, with London gas, an efficiency of 2½-candle power per cubic foot. This is a very generous estimate, the average efficiency of open burners in practice being more commonly 1½ to 2, and the smaller sizes even less. With this explanation, the following table will give the relative cost at London prices of lighting an institution requiring a total light of 4,000-candle power for 1,500 hours annually with electric incandescents, Bray burners and Welsbach lamps.

COMPARATIVE ESTIMATE.—ANNUAL COST OF MAINTAINING LIGHTS OF 4,000 TOTAL CANDLE POWER FOR 1,500 HOURS BY ELECTRICITY AND GAS.

Electric Incandescent—			
250 16-candle lamps, each absorbing 64 watts; cost of current at 6d. per unit	£600	0	0
Renewal of lamps, 500 per annum, at 1s. 6d. each	37	0	0
Total	£637	0	0
Gas, Open Burners—			
320 Bray's "Special" burners, each giving 12½ c.p. for 5 feet of gas per hour; cost of gas, at 2s. 6d. per 1,000 cubic feet	300	0	0
Total	£300	0	0
Welsbach Incandescent—			
80 "C" burners, each giving 50 c.p. for 3.6 cubic feet of gas per hour; cost of gas	54	0	0
Renewal of mantles (240) and extra upkeep, 3s. 6d. per burner per annum	14	0	0
Total	£68	0	0

Economies can, of course, be effected in electric lighting by the use of small lamps (8 candle) in places where only a little light is required, and also by making the most of the facility afforded for turning the current on and off as required. These advantages are almost entirely met in the Welsbach system by the new small lamps now being supplied, which burn only 1 to 1½ cubic feet per hour, and by the almost universal use of the by-pass burner.

Making all due allowance, however, for some advantage which electric lighting certainly possesses in these and other respects, we cannot help being impressed by the broad deduction from the above table, that

electric lighting is twice as dear as the old gas system, and nine times as dear as the Welsbach.

When the new incandescent burners are commonly adopted, the advantage of the Welsbach will be further enhanced.

As some provincial institutions have no access to public electric mains, the following estimate may be useful. It represents the cost of laying down an electric generating plant and installation of 300 16-candle lamps, and the annual outlay for the maintenance of the light, together with the cost of an equivalent of gas lighting.

Electricity—Outlay on Plant:

Gas engine, 35 brake horse power	£300
Dynamo, 25 kilowatts	160
Accumulators	350
Lamps, switches, wire, fitting, etc.	275
	£1,085

Annual Expenditure, 1,500 Hours:

Renewal of lamps, 600, at 1s. 6d.	£45
Depreciation and upkeep, 10 per cent. on £810	81
Labor	40
Gas and oil	110
Interest on plant, 4 per cent. on £810	32
	£308

Gas—Welsbach Incandescent: Annual Cost for Equal Light:

Gas at 2s. 6d. per 1,000 cubic feet	£65
Renewals of mantles, etc	17
	£82
If current has been supplied from electric mains at 6d. per Board of Trade unit, the annual cost of electric lighting, including lamp renewals, would have been	£765

The one main and undoubted advantage offered by electric lighting is that it does not pollute the air we have to breathe. In the old days of gas lighting this air pollution was, in ill-ventilated rooms, a more serious matter, but now that we get the same light as formerly by burning only from one sixth to one-tenth the amount of gas, this objection to gas lighting has practically vanished.

A little calculation will make this clear: A room containing 3,000 cubic feet is amply lighted by a single Welsbach. If the ventilation is as usually provided, the circulation through the flue and other outlets and inlets will cause the air contents of the room to be thoroughly changed at least three to four times per hour, the circulation being, in fact, assisted by a gas burner through the differences of temperature which it sets up. Thus we may say that about 10,000 cubic feet of outside air enter the room hourly. Now a Welsbach burner, consuming 3.6 cubic feet of gas per hour, produces about 2 cubic feet of carbonic acid gas in the same time. After the lamp is lighted the extra quantity of carbonic acid in the room, resulting from the gas, will gradually, in an hour or so, rise to its maximum, and can never exceed 2 per 10,000 of air. Now this is about half of what already exists in the mountain air of Ben Nevis, and may be altogether disregarded in its effect on health.

Of course, when it is said that because an adult expires only .6 cubic feet of carbonic acid hourly, therefore, a gas burner is as bad as three or four adults, this is only true in the matter of the comparatively innocuous carbonic acid gas which they put forth. It is the organic exhalations from human beings which are a real source of danger, and not the products of combustion of a good gas burner.

The writer in 1894 made a careful test of the purity of combustion in the Welsbach burners. Not the slightest trace of acetylene could be detected, and it was a fair inference that no carbon monoxide was present. Subsequent direct tests by a committee appointed by the *Lancet* established conclusively the entire absence of carbon monoxide. Even the competitors of gas lighting do not now venture to suggest that the combustion in a Welsbach burner is otherwise than perfect. The flame in the new Welsbach burner is, perhaps, the most perfect Bunsen flame ever produced, the inner cone being reduced to a beautiful blue ring not more than 3 millimeters high, indicating an almost theoretically perfect mixture of gas and air.

It has often been remarked that the Welsbach light is trying to the eyes. Of course this is true of any powerful light if looked at directly, but lights are not made to be looked at, they are intended to illuminate objects which we want to look at. The eyes are usually and easily protected from the direct light of a lamp by opal or other screens.

Oculists do not appear to have put forth any quantitative statements on this subject, but it seems natural to assume that the tiring effect on the eye would depend on one or both of the two following factors: (1) the total amount of luminous energy reaching the retina, and (2) the intrinsic intensity of the image of a bright body. If the first factor is the main one, then diffused daylight should be far more injurious than many Welsbach lamps. If the latter, then a glowing electric filament would be more likely to produce local injury to the retina of the eye on account of the smallness of the image in which the light is concentrated compared with that of a Welsbach mantle at the same distance.

To insure the best success in the everyday use of Welsbach lamps, attention to a few simple details is necessary, and it may be useful to enumerate here the chief instructions given to those who manage the lights at the Yarrow Home, and which have conduced to the satisfactory results obtained there.

1. Don't leave the gas tap full on, but turn it back until the best light is shown. The gas flame should just fill the mantle. Any more gas burnt gives less light and is only wasted.

2. If a black deposit of carbon should form at the top of the mantle, this is either due to a dirty burner or too much gas being burned. Turn the gas down till the flame only fills one-half of the mantle, giving very little light; the deposit will, in a few minutes, disappear by oxidation.

3. When lighting a burner at the top of the chimney, wait a few seconds after turning the gas on and before applying the light; this prevents shock to the mantle.

4. Burners, especially in dusty rooms, sometimes get clogged by dirt and give poor light. When this is the case carefully remove the mantle from the rod, take off the gallery, and blow vigorously through the gauze or scrub it with a brush. Remove any dust also from the gas nipple by blowing through the air holes at the bottom of the burner; replace and relight. This almost invariably results in a great increase in the light.

The following extract from the report, just received, of the Richmond Public Library Committee shows the result of the removal of the "Wenham" gas burners in that institution and their substitution by incandescent burners, in the effecting of which the writer was instrumental. It concludes this article, and should encourage those who are meditating the installation of Welsbach lights:

"The adoption of the incandescent system of gas lighting referred to in last year's report has quite satisfied all expectations as regards increased cleanliness, superior quality of the light, greater purity of the atmosphere, and reduction in the amount of gas consumed. The saving in expense by the new system during the year 1897–8 amounted to £21 13s. 4d., or 32 per cent. of the previous year's cost."

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, ENGLAND, January 10, 1899.

Christmas and New Year.—Electricity Supply.—Cost of Gas and Electricity.—Welsbach Lights in Liverpool Streets.

The custom of sending out Christmas and New Year cards, which was originated about 50 years ago, and quickly came into favor as a purely social function, appears to have developed, in late years, not only into an ordinary business courtesy, but also to a form of advertising. The value of these remembrances rests entirely in their personal application. The importance of a card setting forth the advantages of somebody's unsurpassable tubes, or coal, is not enhanced by a pictorial wreath of holly and mistletoe, or by seasonable sentiments in gilt letters on the other side. There is some pleasure in receiving a tasteful little souvenir from the old friend who has supplied meters or fittings for the last 25 years, and for whom we entertain personal feelings of respect and esteem; but this does not apply to the effusively familiar card—certainly a very creditable specimen of decorative printing—which is scattered by the thousand from the counting house of, let us say, Bounce's world-wide emporium for anything and everything, and is evidently regarded by the sender as a gigantic spider's web cast out over the length and breadth of the land, with the entrance to the order department of the said emporium at the center, and issued not to personal friends so much as to likely customers. Several of our best firms issue pocket diaries and date cases, specially adapted for gas managers, and many of these have been brought to a very high degree of perfection, the special information, tables, etc., being well selected and edited. A novel feature this year is to include an accident assurance coupon entitling the holder to handsome compensation for injuries received while traveling by rail, car, or other conveyance, which is a

double-barreled compliment, as a testimony of the careful management exercised by our railway and carriage companies, and also to the steady and regular habits of gas engineers. The aggregate sum represented by these coupons as received by your English correspondent within the last fortnight represents some thousands sterling, and assuming them all to hold good, an accident involving severe mutilation would not be an unmitigated misfortune, to say nothing of the delights of sitting amongst the joyous Christmas gathering and discussing the handsome sum that would be secured by "losing an eye," or whether the loss of "one arm and one leg" would be equally profitable. As usual, some excellent samples of the caricaturist's art are also to hand, together with more solid remedies in the form of year books and directories.

The weather during the recess has been mild and free from fog, a condition of things not specially favorable to business. This, indeed, applies to the whole season, that is to say, to so much of it as has already elapsed, but sales have been well maintained. The demand for gas continues to increase, having been greatly stimulated by the introduction of the new Welsbach burner, and stocks of coke are low, thanks to the South Wales strike. The idea of a coal strike proving advantageous to gas interests appears at first sight to be somewhat contradictory, but the explanation is that but few gas coal mines were concerned in the Welsh dispute, the majority being anthracite or smoke less fuel colleries. In a few isolated cases some hardship was experienced, but the general rates for gas coals were not affected, while users of anthracite turned to gas coke as a substitute, and following the usual custom are not inclined to throw over the friend in need immediately the strike is over. Tar is still low, notwithstanding the valuable products it contains, and the best outlet is to burn it, or make tar pavement.

Sulphate shows a steady recovery from the depression that has prevailed for a few years, so that altogether the outlook in the residuals market is favorable. There have been a few accidents from explosion or suffocation, but nothing calling for special mention or anything approaching the sad catastrophe which has caused so much sorrow and suffering at New York, and which has aroused a deep feeling of sympathy on this side. We shall of course look with great interest for the reports of the official inquiries, in the hope of obtaining information that may be useful from a professional point of view. But the first feeling is one of sympathy for the survivors of those who have lost their lives, for the injured ones, and for those whose property has been wrecked or who have to bear the financial loss, which must be heavy.

The holiday season, however, appears to have proved a great strain upon electricity companies. At Norwich, on the Friday evening before Christmas, the electric lights began to kick and flicker, about 5 P.M., and finally failed completely at 6 P.M. After two hours' stoppage, an attempt was made to start again, but the current was too strong this time, and melted several safety fuses, besides doing other damage. The difficulties in Dublin, already noticed, are not remedied, and a consumer remarks that the light exhibits a playful tendency to go out and leave premises and their occupants in darkness. Complaints are still rife at Chelmsford, and the electric companies admit that there have been extinctions due to accidents at the generating station, where considerable alterations are in progress. As regards insufficiency in private lighting, however, the company fall back upon local defects, and say that in nine cases out of ten the house fittings are at fault, or that the consumer has put on more lights without notifying the company. What would be thought of a gas company that required notification of every additional gas light! It seems that the old tale of a 3-light meter and ¾-inch service being expected to supply 15 to 20 lights and a stove or two, is to be repeated with an electric coloring. Apart from defective fittings, however, it is evident that things are far from perfect at Chelmsford, and perhaps after a little more experience the electric company will find it desirable to follow the practice of gas companies and carry out alterations during the light season. Then there have been serious complaints from the city of London, where it is said that the light flickers away to a mere glimmer as soon as the full load comes on in the afternoon. Here again, important alterations appear to be in hand. The company acknowledge that they have not been able to cope with the demand between 4:30 and 6 P.M.—the time of greatest consumption—and ask indulgence on the score of accidents due to the great strain on the apparatus, and of the failure of contractors to make deliveries at the appointed time. They remark that the short supply is a great loss to them, as the meters do not register properly when the pressure is low. As the electric meters are admitted to vary in accuracy according to the pressure, it would be interesting to know the limits within which they register accurately, and also the effect of a high pressure, as well as of a low one.

It is now generally acknowedged that with gas at 3s. per 1,000 cubic feet or less, the cost of 1,000 candle hours by means of the new Welsbach burners is not more than the equivalent of one halfpenny per unit for electricity. A unit of electricity is estimated by electricians to be capable of yielding 264 candle hours. The new Welsbach is capable, as verified by my own experiments, of yielding a duty of 30 candles per cubic foot of gas consumed, so that the actual cost for gas comes out about one-third of a penny. The electricians take care to remind us that the Welsbach burner deteriorates with use, and that the mantles require frequent renewals. But they find it convenient to forget that the same applies to glow lamps. Their outside life is put at 1,000 hours, and a nominal 16 candle glow lamp is averaged as not exceeding 14 candles, Whether either of the two—the Welsbach or the glow lamp—offers a marked advantage in practice over the other in the matter of deterioration or of durability is a difficult point to decide. So much depends upon the care exercised by the user. Intelligent gas consumers are beginning to find that much of the so-called deterioration of the Welsbach mantles is simply due to accumulations of dust, and that a puff with the air spray will restore the mantle to its original efficiency. But in any case there is no reason whatever for crediting the glow lamp with a marked superiority over the Welsbach, and the figures above given, so far as they relate to gas, are not the results of scientific juggling in the laboratory, but are obtainable by any intelligent consumer. It is necessary to enter somewhat fully into this matter, because attempts are being made by interested parties to belittle the results obtained with the Welsbach burner. The *Western Mail*, a leading Welsh newspaper, quoting from a circular issued by the Newport Gas Company, points out that the cost of a 25-candle gas burner would be 3s. per 1,000 hours. With the electric light at 6d. per unit, a similar amount of light would cost 30 shillings. As to the cost of mantles, etc., the Newport Gas Company are prepared to undertake maintenance for 2s. per burner per annum, and the cost of the Welsbach is about one-third that of fitting up electric lamps. At Newport, therefore, a gas consumer could provide himself with a No. 2 Welsbach at the cost of about 10s. It would consume 2 cubic feet per hour, and yield an average of 50 candles. Used for 1,000 hours per annum, the cost for gas would be 6s., and the Gas Company's fee for maintenance 2s., making 8s. in all. The cost for a similar amount of light by means of electricity would be £3, exclusive of renewals of lamps, or certainly eight times as much as gas.

With these figures in view, one is not surprised that the Corporation of Liverpool find it more economical to light their streets my means of Welsbach burners, although they are owners of an electricity supply plant, and the gas is furnished by a Company; 3¾ miles of road are lighted with electric arc lamps, and 76¼ miles by means of Welsbach burners, and the incandescent gas system is to be extended each year as funds will permit. It has effected an economy in cost, while largely increasing the light, on the old flat flame system, and the funds thus rendered available could be expended in the extension of the new system. Such is the recommendation of the Corporation superintendent of street lighting, who adds that by this means the entire lighting of the city by means of incandescent gas lamps would be accomplished and completed in four years. The lighting value would be then greatly increased, while the permanent charges would be reduced. Mr. Bellamy's scheme is applicable to all sorts of gas installations, public and private. It is open to every gas consumer to put in Welsbach burners, and to expend the sum so saved in a further supply, and so on till the whole system is converted, when he will find himself, without having expended a penny more than formerly, in possession of a system of lighting that is three or four times as efficient as the old one, and very much less costly. In many cases it would pay gas companies to provide the Welsbach burners on the hire purchase system, and the saving in gas would be more than sufficient to pay the rent, while the consumer at once receives the benefit of the increased light.

Turf Briquettes in Germany.

Mr. John E. Kehl, U. S. Consul in Stettin, reports the following practice in Germany respecting the manufacture there of turf briquettes: The wet turf, as cut from the moor, is put in a breaking machine and reduced to small pieces; and it then passes to a second machine which cuts and grinds it quite fine. This turf powder or "mull" is dried by passing it through a cylinder carrying exhaust steam from the engine; the inside of this cylinder is filled with large steam tubes and is continually revolved on an angle. From this cylinder the "mull" passes to the hopper of a pressing machine operated by a 75-horse power engine. This press makes 80 briquettes per minute or 35 tons per day.

These turf briquettes retail at a little more than 8 briquettes for 1 cent. Among its advantages are great cheapness; it is clean in handling; packs well in bins and gives a good heat. At Langenberg the cost of material and working is about $1.55 for one ton of briquettes; but this cost is figured on wages of 75 cents per day for a man and 25 cents for a woman.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

AT the annual meeting of the Newburyport (Mass.) Gas and Electric Company the officers chosen were: Directors, L. B. Cushing, T. C. Simpson, William R. Johnson, Samuel March, E. P. Dodge, N. N. Jones and Dudley D. Tilton; President, William R. Johnson; Treasurer, Dudley D. Tilton; Superintendent, Jas. Dickens. Mr. W. H. Swasey, who served for many years on the Board of Directors, declined a re-election. Subsequently the Directors ordered a reduction in the gas rate, on the following basis: Gross, $1.70 per 1,000 cubic feet, with 10 cents per 1,000 off for prompt payment—within 10 days. The concession applies to all gas used since the 1st inst. The old rate was $1.85 per 1,000 cubic feet gross, with 5 per cent. off for prompt payment.

WE regret to report the death of Mr. Jonathan Kehl, for many years a Director in the Pottstown (Pa.) Gas Company, who passed away the evening of the 19th inst. Deceased was born in Limerick township, Pa., August 21, 1838, and his business career had been a most successful one. He is survived by two sons and two brothers.

THE proprietors of the Municipal Gas Company, of Albany, N. Y., have declared a regular dividend of 2 per cent. and an extra ½ per cent., both payable the 1st prox.

THE offices of the Orange branch of the Essex and Hudson Gas Company, of Newark, N. J., are to be removed to commodious quarters in the premises at Main and Center streets, Orange.

AT the annual meeting of the La Crosse (Wis.) Gas Light Company the following officers were chosen: Directors, J. J. Hogan, F. A. Copeland, G. Van Steenwyk, Jas. McCord and C. H. Greenwood; President, J. J. Hogan; Secretary and Treasurer, C. H. Greenwood.

THE Stroudsburg (Pa.) *Democrat*, of the 19th inst., prints the following suburban tale: "The Monroe gas works have again changed ownership, Charles E. Fennessy, of New York, having purchased them from his brother, A. L. Fennessy. Mr. Fitzgerald, the Manager, has severed his connection with the plant, but the other employees remain. A peculiar feature of the transaction is that A. L. Fennessy sold out to an unknown buyer, the business being done by lawyers. He afterwards found it was his brother that purchased."

THE following notice, issued from the office of the Cleveland Gas Light and Coke Company, and signed by Secretary Beardslee, carries its own explanation: "The destruction of the bridge over Kinsbury run at the Nickel Plate Railroad, has severed the largest gas main supplying the district lying south of that point—that is, the Newburg district. There are, however, two other sources of supply; one through Forest street and another through Broadway. Notice is hereby given that the supply of this territory may be temporarily disturbed, but that every effort on our part will be made to eliminate the trouble as soon as possible, but it may be a few days before an adequate supply can be furnished."

THE proprietors of the Winchester (Va.) Gas and Electric Light Company have determined to expend several thousand dollars on the improvement of the gas division of their enterprise. A new gasholder is in the specifications.

A CORRESPONDENT in Sioux City, Ia., forwards the following: "The authorities will receive $1,250.81 from the Sioux City Gas Light Company, as its 2 per cent. share of the sales of gas and electric light to other customers than the city during the seven months ended December 31. Reports were received by the City Clerk to show that the gross sales during the year from the date of the contract between the Company and the city were as follows: Gas, $48,203.02; city's 2 per cent., $964.86; electric lights, $14,297.52; city's 2 per cent., $285.95." Our informant adds that these amounts were somewhat disappointing, larger sums having been expected by the authorities. In fact, it had been hoped that the city's share would be sufficient to pay the expense of street lighting during the rest of the year.

AT a town meeting of Revere, Mass., held about a fortnight ago, the Selectmen presented the report of the special committee which had under consideration the proposition to establish a gas plant to be operated on municipal account. The report, which was a lengthy one, recommended that the town make an arrangement with the Massachusetts Pipe Line Gas Company to purchase gas from the latter, the town to establish and operate a distributing plant. The matter was debated at great length, and the final result was the order that the subject be made a special article in the warrant for the March town meeting, so that the authorities could be legally put in position to undertake the process of establishing a municipal plant.

MR. J. H. HOERTZ, official gas inspector for Louisville, Ky., has submitted his annual report for the year ended December 31, 1898. From its statements it is seen that he inspected 677 meters—277 of which were examined on the complaints of consumers, the remaining 400 being new meters retested for the Company as required by law. The tests showed that 119 meters registered fast, with an average error of 2.06 per cent.; 460 averaged slow, and 98 registered exact. The average error over all was 1.26 per cent. slow. The governing ordinance declares that a meter is to be accepted as accurate when shown to be within the range of 2 per cent. fast to 3 per cent. slow. The amount of sulphur found in the gas averaged 10.38 grains per 100 cubic feet—the maximum allowed is 20 grains per 100 cubic feet; the ammonia content was also well within the limit. The candle power of the gas, which is required by law to be 16 candles, was always above that mark, the highest being 22.22, in August; the lowest was 16.20, in April. The average specific gravity of the gas was 0.475. During the year 59 gas lamps were discontinued, leaving only 10 in the service. Electric arcs, numbering 1,446 and costing $113,659.05, were in use; the gas lamps were maintained at a cost of $664.08. The cost of gas used in public buildings during the year was $5,676.72.

MR. HENRY L. DOHERTY, Manager of the Madison (Wis.) Gas and Electric Company, has been elected President of the Northwestern Electrical Association.

AT the annual meeting of the Capital Gas Company, of Sacramento, Cal., the following Directors were elected: Oliver Eldridge, C. E. Green, J. B. Crockett, Frank Miller, J. E. Terry, Benjamin Welch and Zach Bithell. Mr. B. U. Steinmann, who served the Company in an executive capacity for more than a score of years (he was its President for 16 years), declined an election to the Board.

THE Board of Directors of the Williamsport (Pa.) Gas Company have arranged for an issue of $350,000 first mortgage 5 per cent. bonds. The bonds are to run 40 years, and the interest will be made payable at the office of the trustee (the Fidelity Insurance, Trust and Safe Deposit Company, Philadelphia and New York), on February 1 and August 1.

IN the Appellate Division of the New York Supreme Court was handed down an order some days ago, in respect of the application of Theodore E. Hancock, as Attorney-General, for leave to bring an action to annul the charter of the City Gas Company, of New York. The right to bring the action was affirmed.

THE following action was taken at a meeting of the Directors of the Charleston (S.C.) Gas Light Company, held the 18th inst.:

"At a meeting of the Board of Directors of the Charleston Gas Light Company the following resolutions were unanimously passed:

"*Resolved*, That the Board of Directors of the Charleston Gas Light Company recommend to the stockholders of the Company that they accept $20 cash per share for their holdings in said Company.

"*Resolved*, That Morris Israel and George W. Williams, Jr., are hereby requested and appointed a committee, with full power to act, to take options from such stockholders as are desirous of disposing of their stock." This action was taken as the result of an offer made by the Baltimore (Md.) Trust and Guarantee Company, which proposes to purchase, control and operate the Charleston City Railway, the Charleston and Seashore Railway, the Charleston Electric Light Company and the Charleston Gas Light Company. The syndicate proposes to issue $2,500,000 bonds bearing 5 per cent. interest, the proceeds to be applied to the retiring of the outstanding indebtedness of the named Companies. It is said that the President of the amalgamated concern will be Dr. J. Lawrence, who now is President of the Seashore Railway.

THE New Haven (Conn.) *Register*, of the 21st inst., said: "An offer of $70 a share flat has been made for a majority or all of the stock of

the New Haven Gas Light Company by a New Haven broker representing New York capital. The offer was made to President A. W. De Forest and Mr. E. Hayes Trowbridge, a Director in the Company. It is said they told the broker it would be useless to proceed further with the offer as they were of the opinion it would not be considered by any of the Directors. The stock of the Company is bid for in the market at 70, but there is none to be had even in small lots. The day the offer to purchase was made 68 was bid by individual investors, but there was none to be had. Its par value is $25."

THIS evening the authorities of Laconia, N. H., will open bids for the public lighting of that place for a period of 5 years. The tenders were asked for the maintenance of not less than 85 arcs of 2,000 candle power each; and for a like number of arcs of 1,200 candle power each. Also, "proposals for lighting said streets by the improved Welsbach system of gas street lighting with 100 or more Welsbach gas lights of the improved pattern, 60 candle power." The specifications declare that the time of lighting is to be "from twilight to twilight every night in the year."

MR. JOHN KEAN, JR., President of the Elizabethtown (N. J.) Gas Light Company, and who is largely interested in other New Jersey gas enterprises, has been elected to the United States Senate from the first New Jersey district, succeeding Mr. James Smith, Jr.

MR. HERBERT LYMAN, for a long time identified with the interests of the Westfield (Mass.) Gas Light Company, died at his home in that city the afternoon of the 16th inst. His wife and two children survive him.

COL. WHIPPLE, of Brockton, Mass., will press for passage in the Massachusetts State Legislature a bill putting the telephone companies under the supervision of the Board of Gas and Electric Light Commissioners. The first section of the bill reads: "All matters relating to the rates and service of companies engaged in the telephone business shall be under the supervision and control of the Board of Gas and Electric Light Commissioners. And said Board shall have full power to recommend such changes in the telephone rates and service as the public interests may require, and to inspect and examine the books, records and accounts of said companies, and to summon witnesses and send for persons and papers at such hearings as may be had before them. And said Board shall have the same rights and powers in the premises as it now possesses in reference to similar complaints brought before it regarding gas and electric light companies, except as otherwise provided in this Act. And no increase in the rates of said companies shall be made without previous approval from said Board."

AT the annual meeting of the Brattleboro (Vt.) Gas Company the following officers were elected: Directors, H. D. Holton, O. D. Estabrook, J. L. Martin, G. C. Averill and C. F. Thompson; President, H. D. Holton; Clerk and Treasurer, C. F. Thompson.

AT the annual meeting of the Evansville (Ind.) Gas and Electric Light Company the Directors elected were: Francis J. Reitz, Robert K. Dunkerson, Thos. E. Garvin, Jacob Eichel, John Gilbert, Herman Wilkiemeyer, Sebastian Henrich and Jas. L. Orr.

A CORRESPONDENT forwards the following under date of the 20th inst.: "Mr. Edward Pearce died at residence, corner of Benevolent and Brown streets, Providence, January 14th. He was well known in the community through the enterprises in which he had investments, and was respected for his high moral character and literary and scientific attainments. Deceased was born in Providence, in 1833, and was the son of Edward and Harriet Pearce. He was a graduate of Harvard University, taking his degree in the same class with President Eliot, with whom he always maintained a personal friendship through life. He had traveled extensively and gave much time to his books, being of rather a retiring disposition. His mill (the Stillwater Woolen Mill) took a great deal of his attention in a business way. He was a Director in the Providence Gas Company, in the Phœnix National Bank, and in the Slater Cotton Company. His wife survives him.

AT the annual meeting of the shareholders in the Sharon (Pa.) Gas and Water Company the following officers were named: Directors, Simon Perkins, T. J. Forker, C. I. Carver and Joseph Forker; President, Simon Perkins; Secretary, J. L. Carver; Treasurer, T. J. Forker.

THE agitation for cheaper gas in Newark, N. J., which seems to have had its inception in the local Board of Public Works, has resulted in an agreement between the Lighting Committee of the Board and President Shanley of the Essex and Union (or Hudson) Gas Company that, on April 1st, 1899, the selling rate is to be put at $1.10 per 1,000 cubic feet; the rate on April 1st, 1900, to be $1.

THE Omaha (Neb.) *Bee*, of recent date, says: "As a royalty upon the gas which it sold during 1898 the Omaha Gas Company has paid into the city treasury $11,097.14, which sum has been turned into the lighting fund and will be used in paying up some of the light bills for 1898, that had not been settled because of lack of funds. During the year the Gas Company sold, exclusive of the gas bought by the city, a total of 247,388,500 cubic feet. A portion of that amount has not been paid for and, therefore, the Company will not have to pay the royalty until the bills are collected. This royalty, which applies on a balance of 221,954,452 cubic feet, amounts to 5 cents per 1,000 cubic feet." In 1896 the royalty (or tax), paid by the Company to the city amounted to $7,410.06; in 1897, to $8,526.20. These tax figures are certainly illustrative of the growth of the gas business in Omaha.

THE Directors of the Equitable Gas and Electric Company, of Utica, N. Y., have perfected the following organization: President, Casimer Tag; Vice-President and Treasurer, H. Keene; Secretary, J. P. Millar; General Manager, E. A. Pinkney.

MR. DANIEL MORRIS has accepted a responsible position with the Hornell Gas Company, Hornellsville, N. Y.

IT seems that Mayor Phelan, of San Francisco, was eventually successful in his efforts to displace Mr. C. L. Taylor from the position of official gas inspector for that city. His successor is Mr. Otis M. Tupper.

THOSE in position to know say that the consolidation of the Columbus (O.) Gas Company with the Central Ohio Natural Gas and Fuel Company is effected. As we understand it the title of the combined enterprise is to be that of the Columbus Gas, Light and Heating Company, capitalized in $5,000,000. Of this sum $3,300,000 is to be of the preferred order, the balance to be common.

AT the annual meeting of the Charlestown (Mass.) Gas and Electric Company the following officers were elected: Directors, J. F. Hunnewell, J. A. Sawtell, Chas. F. Byam, John Turner, C. R. Lawrence, C. F. Fairbanks and Q. A. Vinal; Clerk and Treasurer, Geo. B. Neal.

AT the annual meeting of the City Gas Light Company, of Norfolk, Va., the officers named were: Directors, H. B. Hollins, H. Hodges, R. W. Stevenson, J. G. Womble, F. Yznaga, A. C. Humphreys, M. T. Cooke, C. W. Grandy, H. D. McIlhenny, W. H. White and W. W. Randolph; President, A. C. Humphreys; Vice-President and General Council, William H. White.

A CONCERN known as the American Ether Company has been formed in Richmond, Va., the proprietors of which propose "to manufacture and sell sulphuric ether," and to "make and sell gas for heat, power and illuminating."

The Market for Gas Securities.

The market for city gas shares last week did not differ much from the trading that has prevailed in it for the past six weeks or more, save in respect of the quotations for Mutual. The City Bank does not seem to have absorbed very much Mutual at 300, but whether it has or not the fact remains that 310 is bid for Mutual, holders meanwhile demanding 315. The market for Consolidated broadened out a bit, in respect of volume of transactions, but the range of prices was not startling. To-day (Friday) the opening was made at 190½ to 191, and at noon a sale was made at 191¼. New Amsterdams are steady to strong, the net gain for the week in the common being something short of a point. Standards show no particular change. Brooklyn Union is steady. In the gas situation in Greater New York the dealings in Astoria (L. I.) real estate, which are being conducted by the Crimmins syndicate, are attracting considerable attention.

The feature of the outside market was the sharp advance in Peoples gas, of Chicago, which opened to-day at 117 to 117¼. Bay State showed some strength, and the likelihood is that it will show more strength, although any prediction over this celebrated specialty is like the act of the skater who takes chances over thin ice. Lacledes are stronger, and Consumers, of Jersey City, also reflects the effects of steady inquiry for it. Buffalo gas securities are slow to dullness. Western, of Milwaukee, keeps up its advance, and Detroit gas steadily keeps on to a better marking.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
EDITORS.

CHAS. E. SANDERSON,
MANAGER.

PUBLISHED ON EACH MONDAY OF THE YEAR AT
No. 32 Pine Street, New York.

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NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.
AMERICAN GAS LIGHT ASSOCIATION.
WESTERN GAS ASSOCIATION.
OHIO GAS LIGHT ASSOCIATION.
PACIFIC COAST GAS ASSOCIATION.

MONDAY, JAN. 30, 1899.

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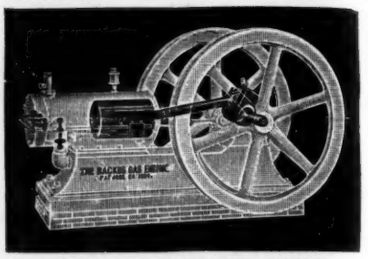

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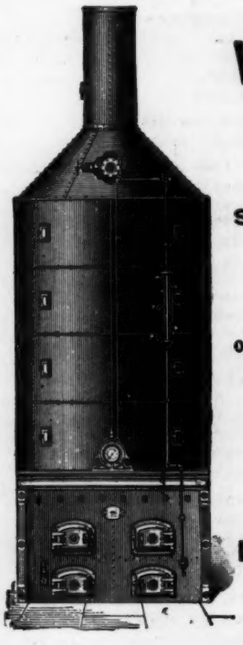

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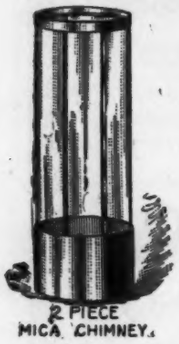

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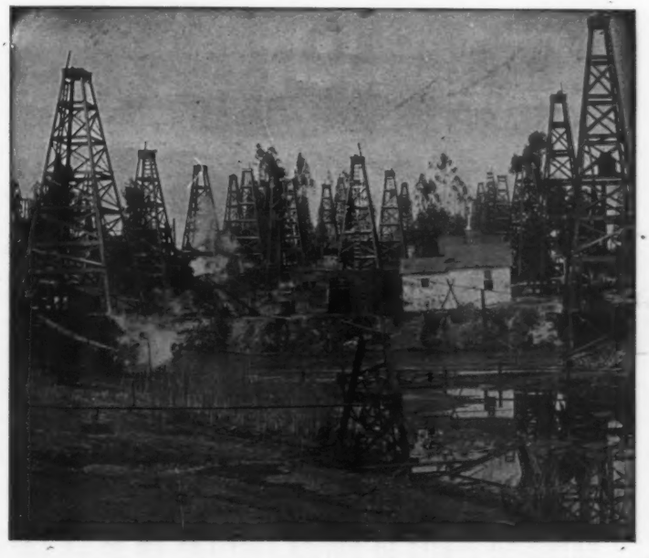

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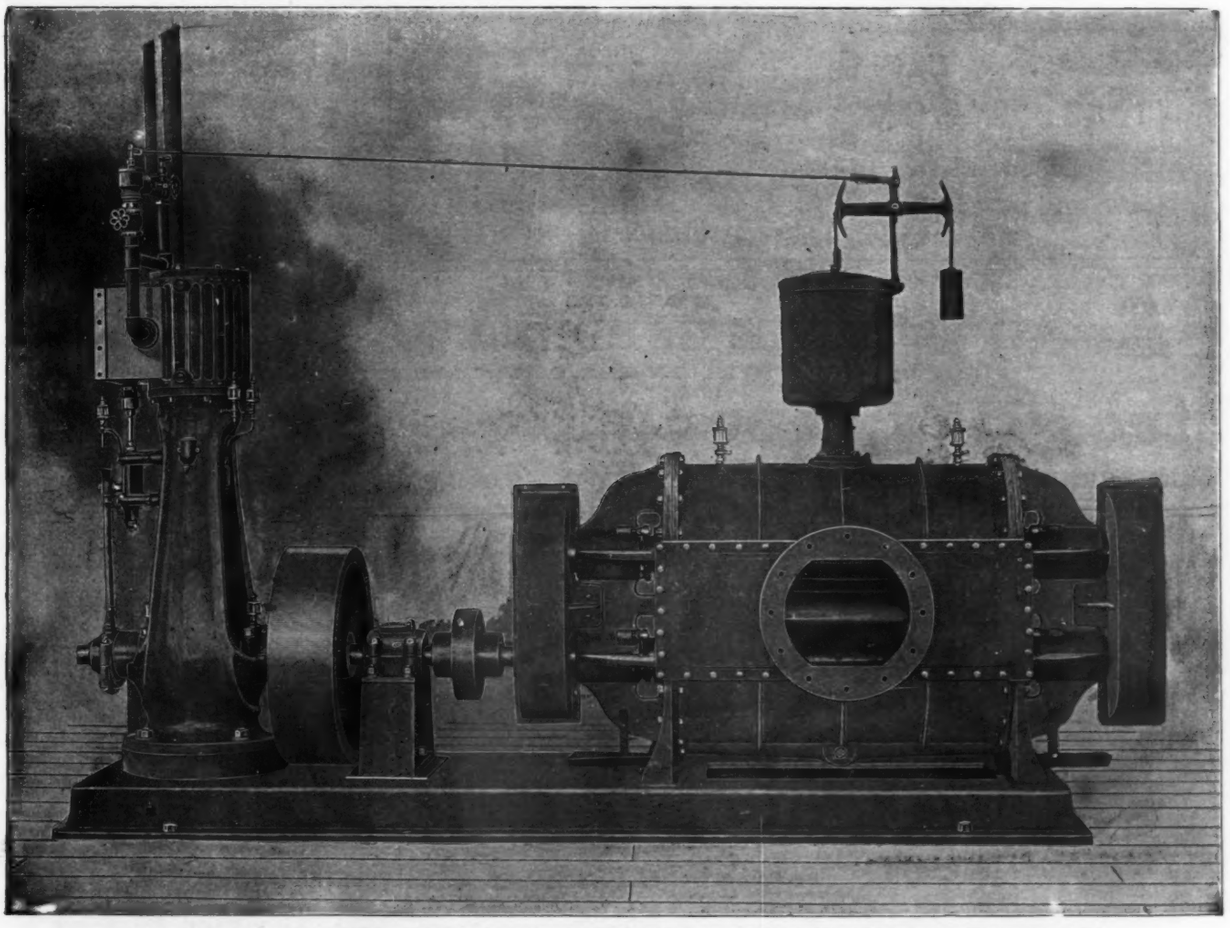

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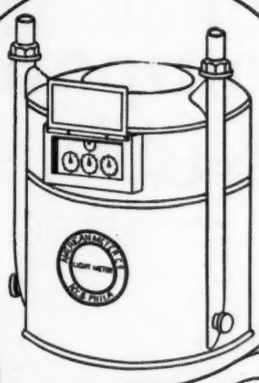

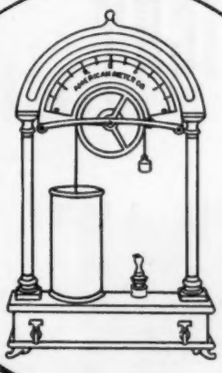

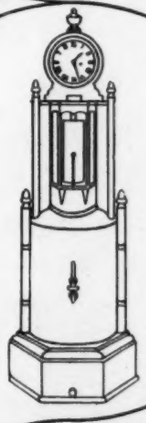

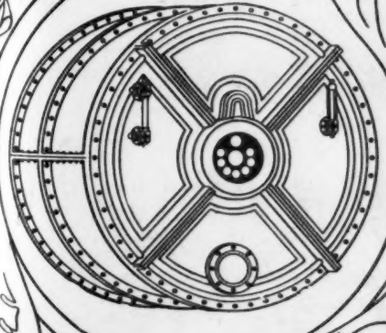

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NEW YORK AND PHILADELPHIA,

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SAN FRANCISCO.

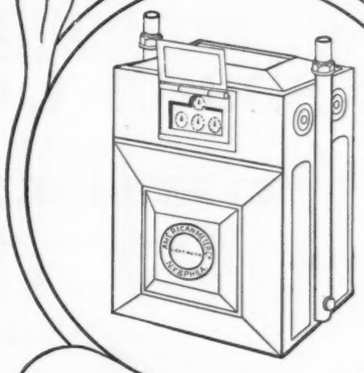
PUBLIC LIGHTING TABLE.

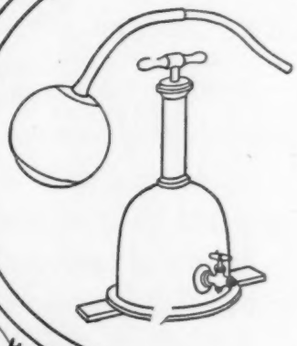
FEBRUARY, 1899.

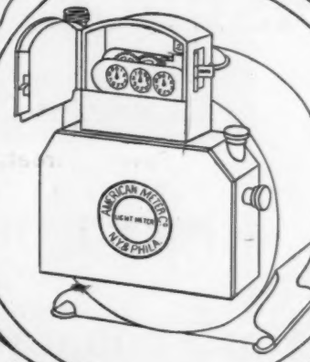
Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Wed.	1	5.50 PM	12.20 AM	5.05	6.15
Thu.	2	5.50	1.30	5.05	6.15
Fri.	3	5.50 LQ	2.40	5.05	6.15
Sat.	4	5.50	3.40	5.05	6.15
Sun.	5	6.00	4.50	5.10	6.10
Mon.	6	6.00	6.00	5.10	6.10
Tue.	7	6.00	6.00	5.10	6.10
Wed.	8	6.00	6.00	5.10	6.10
Thu.	9	6.00 NM	6.00	5.10	6.10
Fri.	10	6.00	6.00	5.10	6.10
Sat.	11	6.00	6.00	5.10	6.10
Sun.	12	6.00	5.50	5.20	5.55
Mon.	13	6.00	5.50	5.20	5.55
Tue.	14	10.00	5.50	5.20	5.55
Wed.	15	11.10	5.50	5.20	5.55
Thu.	16	12.10 AM FQ	5.50	5.20	5.55
Fri.	17	1.10	5.50	5.20	5.55
Sat.	18	2.00	5.50	5.20	5.55
Sun.	19	2.40	5.50	5.30	5.55
Mon.	20	3.20	5.50	5.30	5.55
Tue.	21	4.00	5.50	5.30	5.55
Wed.	22	4.30	5.50	5.30	5.55
Thu.	23	4.50	5.50	5.30	5.55
Fri.	24	No L.	No L.	5.30	5.55
Sat.	25	No L. FM	No L.	5.30	5.55
Sun.	26	No L.	No L.	5.30	5.45
Mon.	27	6.20 PM	9.10 PM	5.30	5.45
Tue.	28	6.20	10.20	5.30	5.45

TOTAL HOURS LIGHTING DURING 1899.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	215.40	January	423.20
February	184.40	February	355.25
March	187.40	March	355.35
April	166.50	April	298.50
May	158.00	May	264.50
June	140.50	June	234.25
July	150.30	July	243.45
August	168.30	August	280.25
September	179.50	September	321.15
October	213.20	October	374.30
November	217.00	November	401.40
December	238.10	December	433.45
Total, yr.	2221.00	Total, yr.	3987.45







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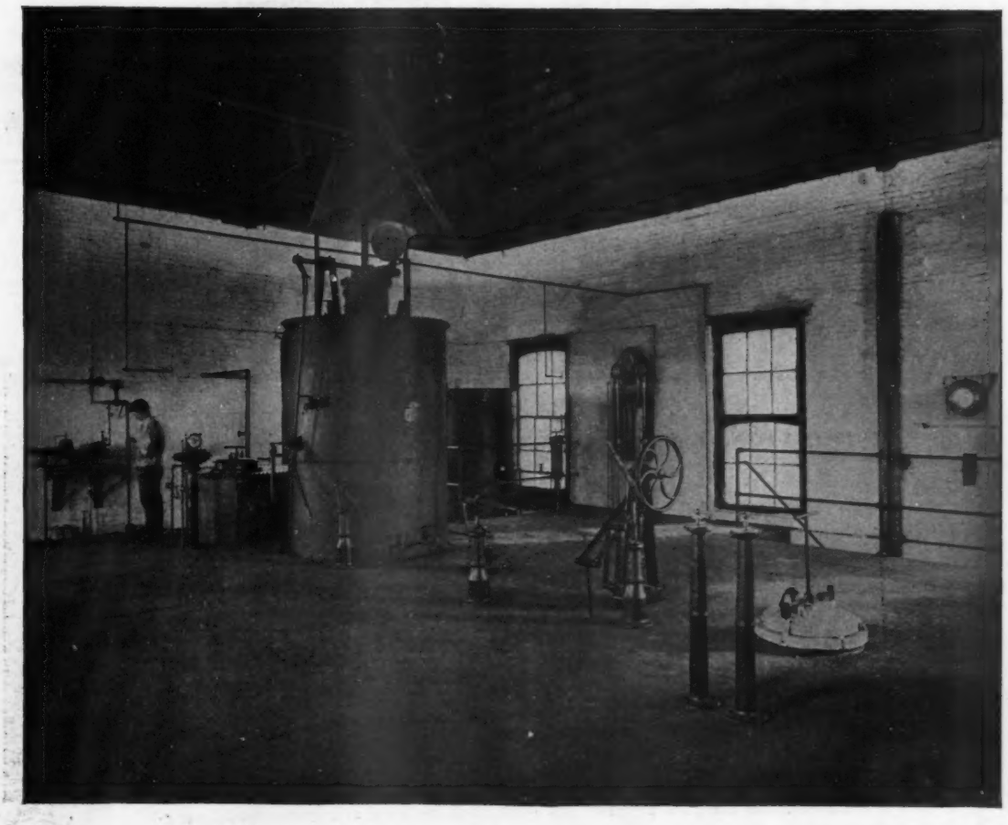

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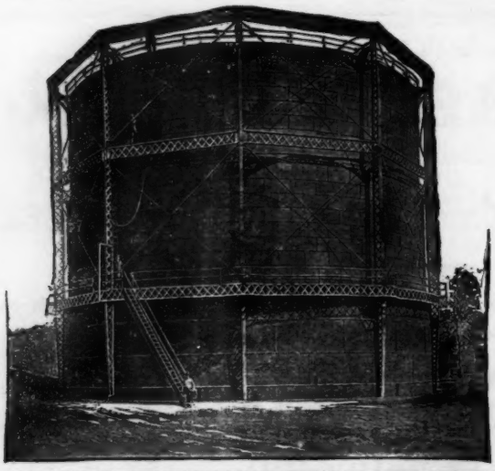

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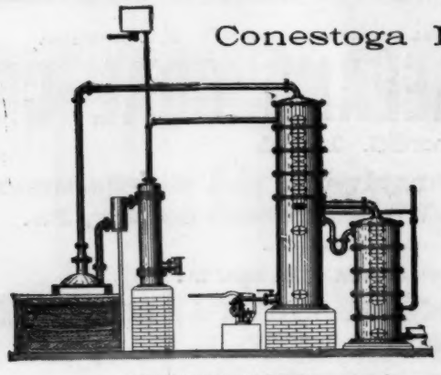

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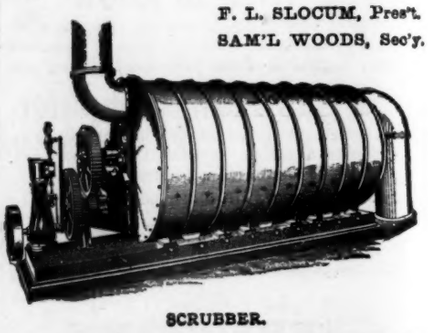

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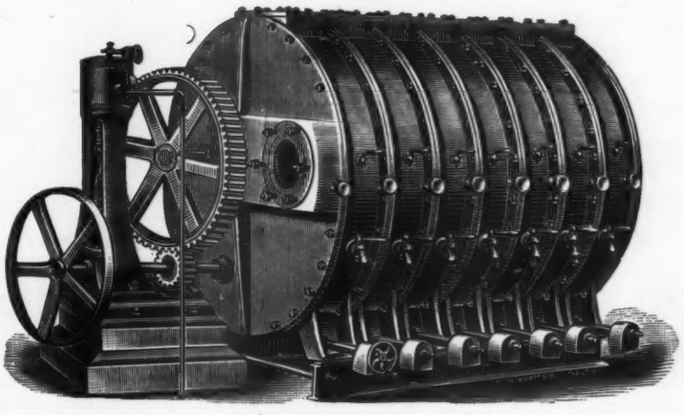

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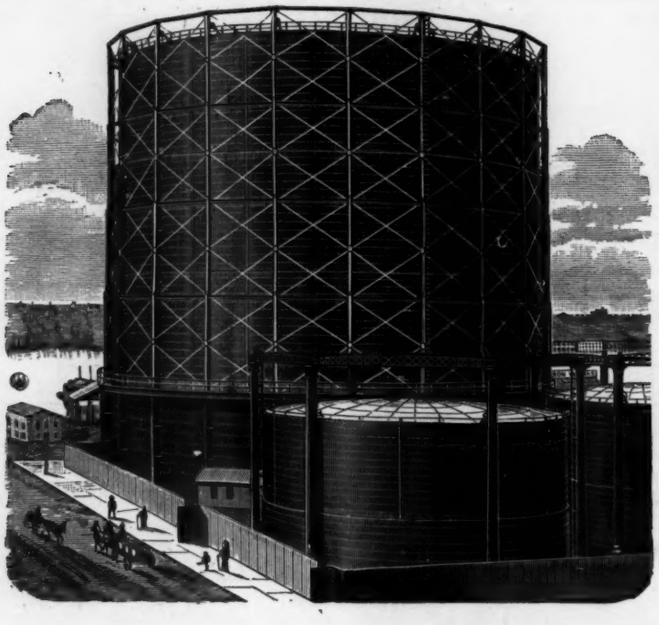

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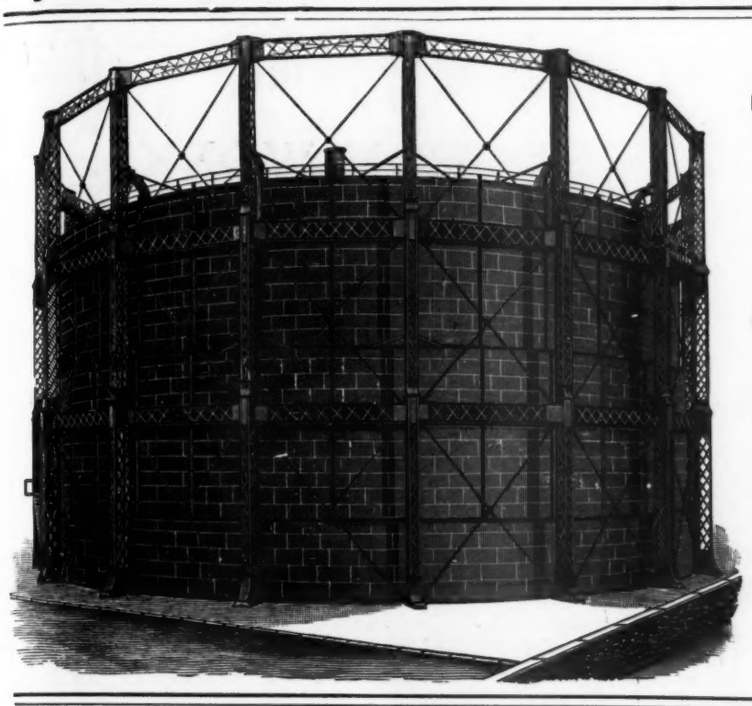

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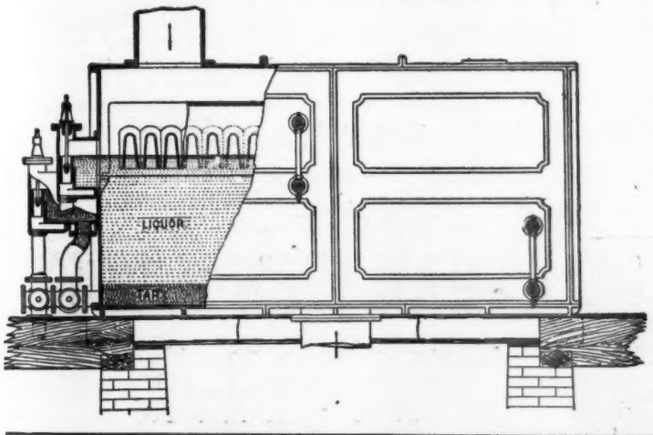

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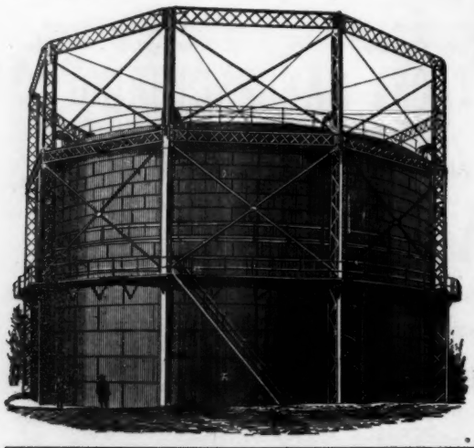

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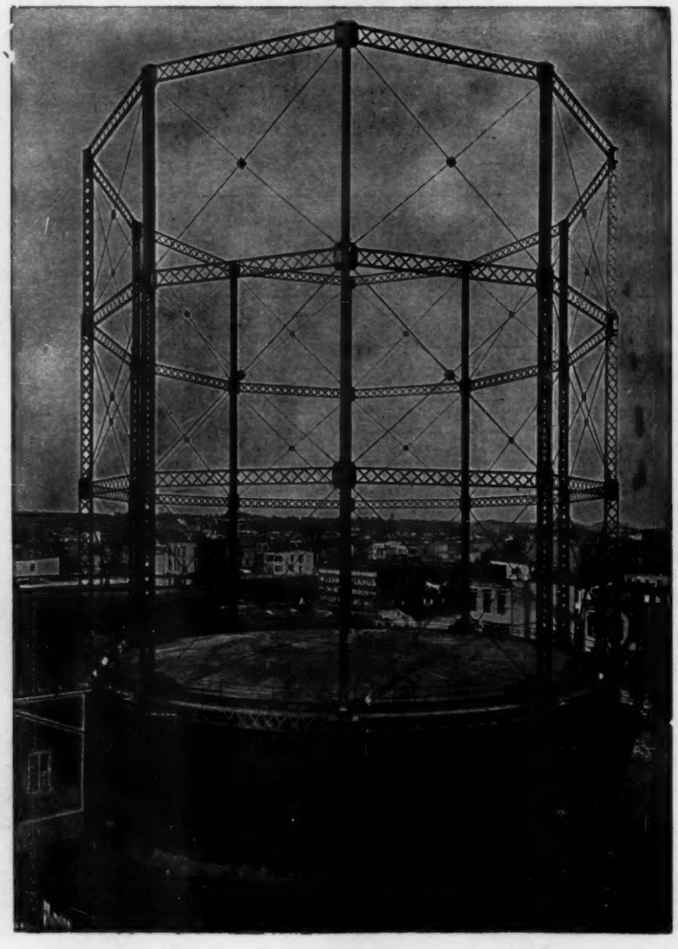

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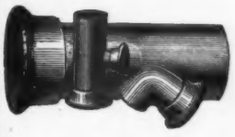

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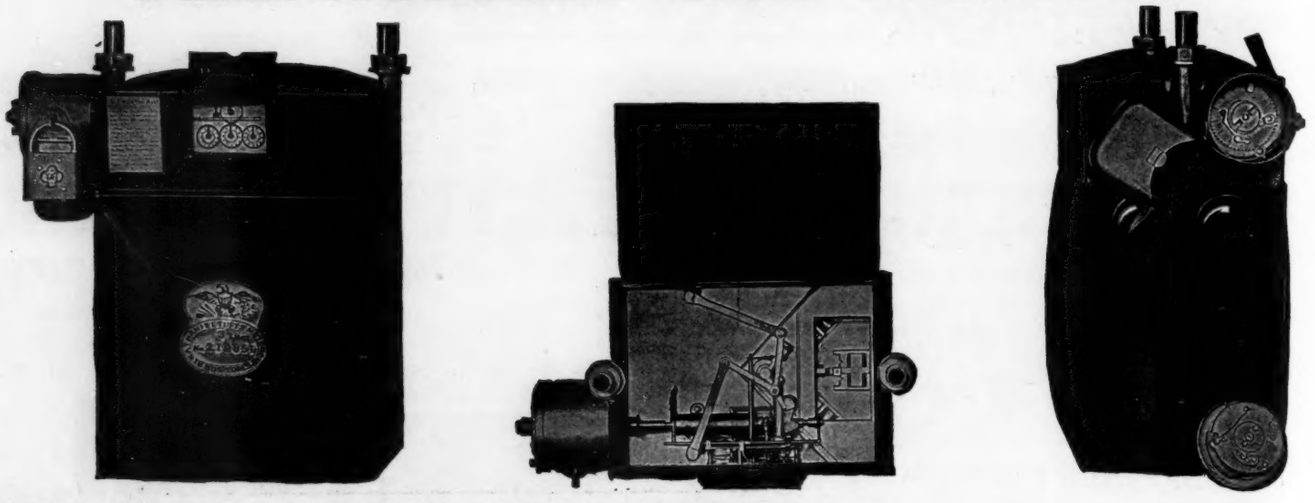

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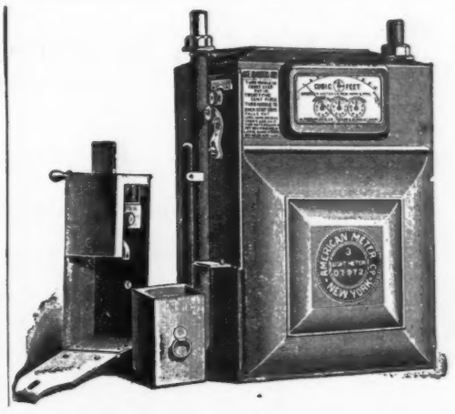

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